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Based on the Statistics of the Long Jump Athletes Three-dimensional Force Analysis of Jumping

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Abstract: Is a key link in the long jump technique, jumping from the Angle of mechanics analysis, can be divided into jumping step and jump. Task is jumping under the condition of rapid run-up, reasonable attempt action change the direction of human movement, to obtain the appropriate body centre of gravity leaps and Angle as far as possible reasonable speed at first. Therefore, the athletes step jump technology to master good or bad, is an important symbol of its movement level. Therefore, to improve the performance of it is to master the complete technical jumping. This article from the perspective of statistical project learning, through the analysis of dynamics, establish dynamic statistical model, discusses the influence factors of phase jumping, which provides theoretical basis for athletes training.

Key words: Statistical model, long jump, three dimensional analysis, jumping technology

INTRODUCTION

Long jump is the body through the rapid run-up and positive takeoff, adopt reasonable posture and movement, the body Banks horizontal distance of sports. For a long time, people have made positive study on the project and has accumulated more research (Zhang, 2013). Yue new wave, Kong Xiangning research showed that the seed, seed is appropriate or not, reflect the quality of the athlete pedal technology according to the athlete individual characteristics determine appropriate seed; Conversion timing should be in the center of gravity of sector Angle projection point before; Jump when the hip Angle is 165~170°, the Angle of the knee joint is 175~178°, the calf is about 65° Angle with the ground; With the improvement of the performance, initiative of takeoff leg tapping plate also increased, accordingly the stud screws up to 65~70°, reduce the Angle of two thighs to 38~32°, the upper Angle of 90~107°, help the enthusiasm of tapping plate. Xia Ling using GM (1, N) model research thinks, our country man jump of voids to 68.7° (Liu, 2005). The study found that: China's long jump athletes with voids of 59.7° and points out that the smaller the voids can make the horizontal velocity loss increase, at the same time also can increase the impact load of takeoff leg when the board, is not conducive to develop and use the leg strength, slow down the speed of muscle to wait long work. Shanghai sports institute Wei Wenyi, roan cotton fang teacher used statistical regression method optimization analysis and numerical calculation, it is concluded that the long jump take-off there exists a best leaps Angle, but it is not fixed. The contemporary level can reach the best leaps Angle can be used than 24°. Rupert j. Ma Ken study found: the ideal leaps should be between 20~25° Angle. Chapter jasper and others in the study of the jumping action is divided into stages of support before and after (Peng and Sun, 2007). Chen Min actions, such as sheen in the original structure are introduced based on stretching and dynamic stretching stage, brake pedal extension moment and the Angle between the vertical supporting surface is called the pedal Angle, the size of the Angle on the one hand, reflects a push to the athletes of the timing, on the other hand also reflects the size of the athlete's leg strength. Xu Gang, Zhang Guimin in research will run the last step began after stretching in an instant as the swinging leg landing buffer jump start time, closely connected to jump into the swinging leg pedal, body empty, after takeoff leg buffering and takeoff leg stretching in four parts. This classification method is more prominent of run-up and take-off movement closely integrated, fully reflects the positive buffer action to improve the body center of gravity leaps the importance of the vertical speed (Fan, 2013). The above understanding of the phases of long jump take-off process, research, not only conforms to jump run-up and closely cooperate with the technical characteristics of takeoff and more reflect the demands of the development of long jump technique.

To sum up, many experts and scholars on the long jump, the degree of different research, but research based on dynamics model for the blank, with the progress of science and technology, some advanced instruments and equipment in the field of sports scientific research, using the means of constantly enrich and can make the project research more in-depth and meticulous, the relevant index to the long jump technology research, the data will also be more precise and gradually reveal its essential feature, form a more correct theory. This article from the perspective of statistical computing science, through the analysis of dynamics, dynamic statistical model is established, discusses the influence factors of phase jumping, training for the athletes to provide a theoretical basis.

RESEARCH OBJECT

The research object of this article is to participate in the long jump athletes during a grand prix track and field, before we take six athletes run-up last two steps and take-off technology, athletes' basic situation such as Table 1.

RESEARCH METHOD

This study uses the mathematical statistics method and gets relevant motion parameters through experiment. We used the statistical software package and the relevant mathematical formulas to calculate and analysis the data. If $p<0.01$, we think it has a very significant difference; If $p<0.01$, we think it has a significant difference.

STATISTICAL ANALYSIS OF THE KINEMATICS IN THE TAKE-OFF TECHNIQUE

Take-off time analysis: Judging from Table 2, 3, 4, correlation coefficient between T2 and performance is the highest (R = 0.745). The time ratio reflects the motor ability of the long jump athlete. In this study, the time ratio of T2 is the lowest; indicating that the athletes lower limb specific physical strength is under insufficient conditions. T1 is a reflection of the ability to convert the reaction force from the footboard to the body into take-off power. T3 shows how fast the swing leg of the long jump athlete could stop moving. In Table 4, the time ratio of T1 and T3 is equal. On the whole, there is still prodigious potential of the athletes' rapid take-off ability. The subsection time ratio of athlete B is the best, which is a main factor that she shows better performance. If athlete C can do a successful take-off and athlete A can improve in this link, they will achieve better results.

Statistic analysis of knee point angle, included angle between swing legs and sector angle at footboard moment: As can be seen from Table 5, the take-off angle of the 6 athletes ranges from 57.98±2.85o, which don't match the Fleche mode (64-69o). Some researchers have demonstrated that the landing angle of excellent athletes is about 63.14o. The average landing angle of the 6 athletes is close to this number with a very significant difference about 5.15o (T-4.41, $p<0.01$). Athlete B's landing angle is the largest (63.45°). The main reason of this result is that athlete B is able to take off in a short time and possesses favorable Stretch time index. Swing leg's landing angle and extension movement under certain run-up conditions determine the direction and time of take-off force. Foot extension when take-off (the angle is much too small) will increase the braking force and extend the action time. As a result, the upper part of the athlete body will lag behind and extension start too early. If the take-off angle is too big, he will jump too high, causing the great losses of horizontal velocity. Takeoff leg is too close to the landing point (Namely landing angle is too big).

Taking athletes' take-off time into consideration, the average take-off time of the 6 athletes is 0.177s, which is

Table 1: Research object situation

Name	Date of birth	Height (m)	Weight (kg)	Sign up score (m)
A	90.04	1.75	67	6.33
B	94.08	1.77	63	6.12
C	91.01	1.78	64	6.37
D	88.10	1.71	61	5.90
E	89.01	1.70	57	6.18
F	80.12	1.76	56	5.92

Table 2: Subsection time statistics during the 6 athletes' take-off stage

Name	Buffer time (T1)	Conversion time (T2)	Extension time (T3)	Take-off time (T4)
A	0.041	0.041	0.041	0.1210
B	0.021	0.041	0.041	0.1010
C	0.041	0.041	0.021	0.1010
D	0.041	0.021	0.061	0.1210
E	0.041	0.041	0.041	0.1210
F	0.061	0.041	0.041	0.1410
Average	0.041	0.037	0.041	0.1171

Ps: T1 is the buffer time when take-off; T2 is the conversion time when take-off; T3 is the extension time when take-off.

Table 3: Statistical analysis of correlation coefficient between subsection time and performance

Phase	Buffer	Conversion	Extension	Whole take-off
r	-0.323	0.745	0.044	0.233
p	>0.050	<0.050	>0.050	>0.050

Table 4: Logo meter of each subsection time during take-off

Category (%)	Buffer (%)	Conversion (%)	Extension (%)
Ratio	34.3	31.7	34.3

Table 5: Motion parameter of athletes' take-off posture

Name	Landing angle	Angle of leg trust	Included angle	Sector angle
A	55.81	72.51	17.50	51.68
B	63.45	77.56	12.44	38.99
C	58.08	76.38	13.62	45.54
D	56.67	73.69	16.31	50.63
E	58.04	74.64	15.36	47.32
F	55.88	73.73	16.27	50.39
X	57.99	74.75	15.25	47.43
S	2.86	1.89	1.86	4.73

Table 6: Conversion rate of athlete horizontal velocity and take-off angle jumping moment (m sec^{-1})

Name	Horizontal velocity of pedal landing (m sec^{-1})	Unstuck speed of squat jumping (m sec^{-1}) Horizontal velocity	Vertical velocity	Losses of velocity (m sec^{-1})
A	9.38	8.04	2.88	1.36
B	9.97	7.33	2.76	2.63
C	10.62	9.13	3.27	1.47
D	10.13	9.04	3.23	1.10
E	9.48	7.82	2.89	1.66
F	8.43	7.51	2.75	0.94
Average	9.77	8.36	3.11	1.39
Standard deviation	±0.66	±0.67	±0.21	±0.54

Table 7: Changing data of included angles between swinging legs during the 6 athletes' take-off stage

Name	landing (degree)	Maximum buffer (degree)	Liftoff (degree)
A	48.35	8.04	98.35
B	38.32	1.22	115.63
C	37.64	10.52	74.69
D	62.84	0.86	100.41
E	74.69	3.42	82.70
F	62.27	15.35	113.57

not so different as the figure suggested by Niger ($p>0.05$). Exceptional athlete's take-off time reaches to 0.10s, showing a faster take-off velocity.

Statistic analysis of horizontal velocity of pedal landing, unstuck speed and take-off angle of squat jumping: In the run-up and take-off process of the 6 athletes, the average maximum losses of velocity is 1.65±0.42 m sec^{-1}, with athlete C's 2.88 m sec^{-1} the highest, which might caused by the unsuccessful cooperation of fast run-up and take-off ability. Elite Chinese athletes and excellent athletes from abroad possess supporting ability and rapid extension ability. Research shows that Chinese athletes' vertical take-off velocity is favorable, while the horizontal velocity suffers huge losses. Therefore, there is further need to improve the training method and enhance the overall performance.

Statistical analysis of the kinematics in the swinging leg: Judging from Fig. 1 and Table 7, the leg angle of athlete C is lower than the others under a reasonable changing scope. Athlete C shows good technology and consciousness to reduce the resistance loss of run-up and take-off stage, with swing leg's strong sense of freedom and reasonable usage of knee point to an active landing. Some shortcomings still exist in the jumping skills, such as the adverse effect of bad footboard technology.

If she had played more attention to take the chance to accelerate swinging after the swing legs' liftoff, the take-off effect might be better. Athlete C's included angle

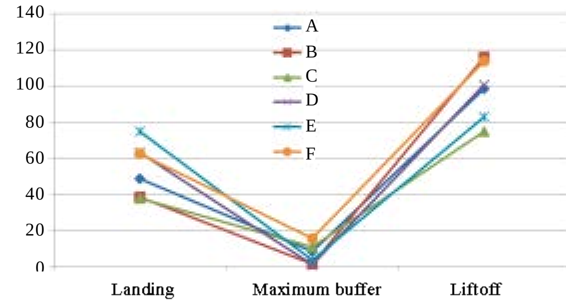

Fig. 1: Change of included angles between swinging legs during the 6 athletes' take-off stage

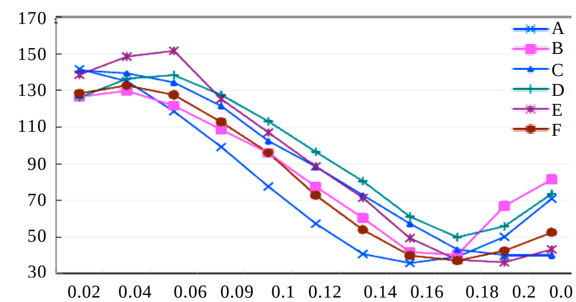

Fig. 2: Variation of knee angle between the swinging legs during the 6 athletes' take-off stage

at footboard is the smallest, but the effect is unsatisfactory, the reason of which may be that the last step of run-up is too long. So as to reduce horizontal velocity loss and achieve the best result, the athletes should better boost the swing of swing legs. Long jump athletes should make full and rational use of swing leg and footboard knee point skill and intensify relative training to enhance their long jump skill level.

From Fig. 2, you can see that the athlete E at the moment the knee Angle is 159.78° and buffering phase time of 0.079 seconds, in 6 athletes buffer time, the largest at the instant of the pedal, athletes of the increase of the vertical pressure, due to reduced the Angle of the knee joint is helpful to jump to reduce resistance, make the center of gravity forward, promote the level of turnover rate method in this game, reduced the departure time, reduce the loss rate of speed. Results the knee joint Angle is too large can cause the body and determine the distance of the ramp is not enough. In actual teaching pay attention to athletes in training from the biggest buffer to the phase of the oscillation amplitude of training from the ground, thus improve the athlete's takeoff effect.

CONCLUSION

Through the above analysis shows that the excellent long jump athlete pedal Angle of moment of knee joint and legs is better, but because of some athletes swinging leg swinging consciousness is not strong, make the pedal weakened; Some time is reasonable, but the buffer time is too long, unreasonable layout, influence the final jump effect; Through the study found that Chinese athletes jump instantly vertical velocity and there was no significant difference between the world elite athletes; But the flight Angle and the best athletes in the world is different, so jump Angle is the influence factors of long jump athletes in our country. Advises athletes in training, to gain higher approach speed at the same time, athletes should pay attention to strengthen the eccentric contraction ability of the knee joint, especially in high speed motion state, the appropriate increase the motion of the swinging leg. Although his Angle it is very important to improve the performance of athletes, but not through the loss of horizontal velocity.

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