Research Article
Optimal Model for Velocity Strength Training Methods for Boy Sprinters Base on Fuzzy Matrix

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Abstract: With literature consultation, Delphi method, fuzzy mathematics, experimental method and mathematical statistics method, from multi viewpoints, this study analyzes the velocity strength quality of boy two-level sprinters in quality and quantity. The result shows, with fuzzy mathematics, we can judge the relative degree between velocity strength and various methods, with quantitative disposal to analyze quantitatively, which has certain theoretic significance; according to analysis of fuzzy relation and corresponding relation, build the classification figure for velocity strength training method for boy sprinters; relative data proof, the optimal organization of different training methods can outstand the training specialization and save time and energy, so as to supplement the special training theories, to provide theoretic references and practical instructions for most coaches' training processes, to improve the efficiency.

Keywords: Boy, Fuzzy mathematics, sprinter, velocity strength

INTRODUCTION

A country's sprint's performance indicates the level of its various sports' development. Sprint is typically led by physical energy. Velocity strength is essential. Without it, the performance is difficult to improve. It is not only an important demonstration of sport ability, but also the important basis for many sport items. It is a basic ability for most sport items, which is one of the requirements of physical energy. Velocity strength is always the important topic for sport training practices in kinesiology. Chinese total level of track and field is backward.

The factors of sprinting performances are a lot, of which the main one is not able to catch the matching relation between velocity and strength in strength training. Some experiences have been accumulated about how to improve such velocity strength. Sprint is a typical physical velocity strength item, which integrated velocity, strength, explosive force, flexibility, and coordination. Since long time ago, global scholars devoted to exploring the sprinting, who have accumulated many performances. From such studies, we summarize 29 training methods and 16 primary indexes (Wang, 1998). The training methods are squatting-distance 30-meter accelerative run, 60-meter accelerative run, upward slope run, leapfrog, drop jump, back shot (5 kg), front shot (5 kg), standing long jump, triple jump, standing fifth jump, run-up fifth jump, run-up tenth jump, run-up strong leg fifth jump, run-up weak leg fifth jump, 20-meter timing single-foot jump, 30-

meter timing hurdling step, touching height with running, continuous jumping box exercise, forward lunge jump, step jump, weight bearing jump, continuous hurdling single-foot jump, continuous hurdling jump, weight bearing bow step strike, weight bearing deep squatting, weight bearing half squatting, weight bearing extracting heel, kettle boll squatting jump and jump pushing barbell (Paavo, 1999). The factors are strength of lower limbs, strength of upper limbs, explosive power of lower limbs, explosive power of upper limbs, strength of pectoral girdle, strength of abdominal muscles, strength of psoas, strength of waist abdominal, explosive strength of the whole body, flexibility of lower limbs, flexibility of upper limbs, flexibility of the whole body, pliability of the whole body, coordination of the whole body, power of hip joint and flexibility of hip joint (Xie and Liu, 2000).

However, many coaches still lack of scientific criteria. There are mainly two points. One is many coaches consider it should hold the development of basic strength, then conduct the development of velocity strength; the other is, while reaching certain basic strength, combine mastering structural practices of technical motions with developing some abilities (Wang et al., 2011). Various physical indexes of boy athletes is in the key transitional period, which needs the systematic and scientific study, forming the complete theoretic system, so as to make our sprinting level to reach world-class level (Wang, 2001). This study uses data model, according to the situation above, analyzes

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Table 1: Basic situation

Group	Name	Training age	Height (cm)	Weight (kg)
A	15.5±1.7	2.56±0.26	167±2.51	59.6±3.68
B	14.2±1.9	3.04±0.39	168±1.21	61.9±2.49

the two-level boy sprinters' velocity strength in quality and quantity.

RESEARCH OBJECT AND ANALYSIS

Research object: Before the experiment, classify the volunteers into two groups with the same condition, which are experimental group (A) and control group (B), Table 1:

No information or hints about the experiments are told to volunteers before and in the experiment, which promises them in the unknown state, so as to promise the credibility and validity.

Research method:
Literature consultation: on the basis of widely reading and dealing with many papers, read and analyze some important relative papers and make classification and comprehension. Meanwhile, according to research requirements, collect and deal with the training methods and indexes affecting the velocity strength. On such basis, set the 16 indexes and 29 training methods as the primary indexes.

Expert investigation method:
Questionnaire design: According to research requirement, design the consultation questionnaire with 16 velocity strength factors and 29 training methods. This questionnaire can be classified into two parts. The first one is to invite specialists to supplement and choose among primary indexes. Select the index with great degree of velocity strength among many indexes. The second section is, on the basis of modification and supplement results, to judge the relative degree. Rule the relative degree as 5 levels: the individual with quite close relationship is 1, the individual with very close relationship is 0.75, the individual with close relationship is 0.5, the individual with not close relationship is 0.25, and the individual with not very close relationship is 0.

Recovery and effective rate of questionnaire. 22 questionnaires are sent to relative specialists. The recovery situation is Table 2.

Three validity and reliability of questionnaire: To promise the validity of questionnaire, meanwhile according to research requirements, collect and summarize the velocity strength training method and index of boy sprinters. On such basis, set 16 indexes and 29 training methods as primary indexes. Invite some relative specialists to conduct content validity test. Seen from the recovery questionnaires, specialists enjoy the content, and design the questionnaire according to specialists' advice. The validity: August, 2007, repeat the investigation. The time interval is 30 days. With the Pearson correlation coefficient method, the result is: the

validity is: $r = 0.89(p<0.01)$, indicating the result is credible.

Fuzzy mathematic method: conduct fuzzy mathematic method on the investigation results in statistics. Conduct fuzzy mathematical matrix to calculate the quantitative evaluation method on the quantitative fractions. Build the multi-layer fuzzy to comprehensively evaluate the problem.

THE MAIN RESEARCH PROBLEM

Build the training method and effective factors system: Velocity strength of sprinters is a complicate system, which comprises of initiative strength, explosive strength and braking power. Explosive power is the most typical demonstrative type of velocity strength, which is the core. The bigger the strength exerted in the motion, the shorter the time is, and the greater the velocity strength is. Then, the development of velocity strength is closely associated with the mastering degree of motion. The higher level of motion skill is, the more effective the muscle coordination is, and the more reasonable mechanical feature, special feature and time feature are. Therefore, when we abstract the indexes which can reflect the velocity strength levels of boy sprinter's, it should be conducted from the multi aspects, like strength, explosive power and coordination. Then the level can be indicated comprehensively. But the indexes have different effects, which require us to reveal the main factor limiting the boy's velocity strength. That is to select the effective index system of velocity strength.

After two-turn selection, definite the 11 training methods mainly affecting the sprinters' velocity strength. They are leapfrog, 20 m timing single-foot jump, continuous hurdling jump, kettle boll squatting jump, weight bearing extracting heel, snatch, weight bearing deep squatting, weight bearing half squatting, 30 m squatting-distance starting run and 50 m hurdling jump; the effective factors are explosive strength of lower limbs, strength of lower limbs, explosive power of waist and abdomen, pectoral girdle, whole body coordination. It indicates, according to specialists' experiences, the 11 training methods and 5 influencing factors above are closely associated with the velocity strength of boy sprinters. They should be the most important indexes of velocity strength.

Fuzzy matrix synthesis between velocity strength training method and factor sets: This study, with fuzzy mathematical method and relative degrees among various factors, calculates specific values. Judge its quality by quantitative analysis. Analyze the training methods and many factors affecting the velocity strength of boy sprinters'. In the questionnaire, invite specialists to judge the correlation between each training method and velocity quality, according to their experiences. According to the result, with fuzzy mathematical method, calculate (priority selection ratio) (Li, 2000).

Table 2: Granting and recovery situation

Turn	Granting questionnaire	Recovery questionnaire	Recovery (%)	Effective questionnaire	Effective rate (%)
First round	22	22	100.0	19	86.4
Second round	22	22	100.0	20	90.1
Third round	22	21	95.5	20	90.1

Table 3: Velocity strength training method and influencing factors judging set

Factor	Explosive strength of lower limbs	Strength of lower limbs	Explosive power of waist and abdomen	Pectoral girdle	Whole body coordination	X
Leapfrog	0.86	0.83	0.81	0.49	0.69	0.74
Continuous hurdling jump	0.93	0.85	0.82	0.53	0.90	0.83
Kettle boll squatting jump	0.75	0.88	0.66	0.38	0.49	0.63
Weight bearing extracting heel	0.75	0.82	0.71	0.23	0.33	0.57
50-meter hurdling jump	0.89	0.81	0.69	0.56	0.79	0.75
Snatch	0.71	0.62	0.72	0.90	0.69	0.73
20-meter timing single-foot jump	0.91	0.82	0.78	0.49	0.79	0.76
Jump push barbell	0.78	0.71	0.67	0.89	0.58	0.73
30 m squatting-distance starting run	0.89	0.77	0.79	0.83	0.81	0.81
Weight bearing half squatting	0.76	0.85	0.68	0.26	0.31	0.58
Weight bearing deep squatting	0.72	0.89	0.69	0.26	0.31	0.58
Y	0.81	0.81	0.73	0.53	0.61	

$R_{ij} = \sum r_{ij}/n = (1 \times$ frequency number $+ 0.75 \times$ frequency number $+ 0.5 \times$ frequency number $+ 0.25 \times$ frequency number$)/n \times 1$.

Which can get the training method and judging factor set? (Table 3).

Then:

$$R = \begin{cases} 0.86 & 0.83 & 0.81 & 0.49 & 0.69 \\ 0.93 & 0.85 & 0.82 & 0.53 & 0.90 \\ 0.75 & 0.88 & 0.66 & 0.38 & 0.49 \\ 0.75 & 0.82 & 0.71 & 0.23 & 0.33 \\ 0.89 & 0.81 & 0.69 & 0.56 & 0.79 \\ 0.71 & 0.62 & 0.72 & 0.90 & 0.69 \\ 0.91 & 0.82 & 0.78 & 0.49 & 0.79 \\ 0.78 & 0.71 & 0.67 & 0.89 & 0.58 \\ 0.90 & 0.81 & 0.79 & 0.83 & 0.81 \\ 0.76 & 0.85 & 0.68 & 0.26 & 0.31 \\ 0.72 & 0.89 & 0.69 & 0.26 & 0.31 \end{cases}$$

Seen from Table 3, X (X indicates the correlation between each training method and U) indicates only the correlations of two training methods, which are continuous hurdling jump and 30 m squatting-distance starting run, can reach bigger than 0.8, and the others have lower levels. It indicates a training method is difficult to reach the best effect of velocity quality training. Therefore, we also prove that velocity strength quality is comprehensive, which should be optimized by integrating many training methods. Y (U indicates the correlations between factors affecting sprint velocity strength quality and V) indicates the relation between factors of velocity strength quality and training method. The Table 3 shows, the values of explosive strength of lower limbs and strength of lower limbs are greatest, indicating the functional degree is greatest. But the velocity strength has the direct relation to strength of lower limbs and explosive power of lower limbs.

In Table 3, any value indicates the correlation between each training method and sprinter velocity strength quality. That is to say, the training method mainly develops the aspect of velocity strength. For example, the continuous hurdling jump's functional degree of pectoral girdle is only 0.53, but its degree of developing strength of lower limb is 0.85. It requires us to select training methods according to their real situations in real practices.

Clustering analysis of training method: Training methods are a lot, and their functions are different. According to the explanations above, we know each training method has its importance. Therefore, conduct a deeper classification analysis, which can provide scientific theoretic basis for training.

Synthesize judging matrix R. According to fuzzy mathematics, in real practice, we always transform the fuzzy relationship to fuzzy matrix. But so-called fuzzy correlation matrix, in real practice, solve correlation matrix among fuzzy and variances in fuzzy statistics (Wang, 1998). According to judging factor set above, according to fuzzy mathematical operation rule, arrange a row matrix R2, then synthesize R1 and R2 (Jing, 2000). Get the matrix R.

$$R = R_1 \times R_2 = \begin{cases} 0.74 & 0.74 & 0.73 & 0.53 & 0.61 \\ 0.81 & 0.81 & 0.73 & 0.53 & 0.61 \\ 0.63 & 0.63 & 0.63 & 0.53 & 0.61 \\ 0.57 & 0.57 & 0.57 & 0.53 & 0.57 \\ 0.75 & 0.75 & 0.73 & 0.53 & 0.61 \\ 0.73 & 0.73 & 0.73 & 0.53 & 0.61 \\ 0.76 & 0.76 & 0.73 & 0.53 & 0.61 \\ 0.73 & 0.73 & 0.73 & 0.53 & 0.61 \\ 0.81 & 0.81 & 0.73 & 0.53 & 0.61 \\ 0.58 & 0.58 & 0.58 & 0.53 & 0.58 \\ 0.58 & 0.58 & 0.58 & 0.53 & 0.58 \end{cases}$$

The synthesis rule for fuzzy matrix is to multiplex selects smaller one, and addition selects bigger one (Li, 2000).

The result of clustering class is: with direct clustering method, conduct fuzzy clustering class on the values in Table 3. Because the values in fuzzy matrix are only during [0, 1] (Wang, 1998), in reality, which show the evaluations on evaluated factors. Get some numbers in the section [0, 1] after systematic processing. When we select a value as section set, if the element in the matrix is bigger than such value, all the values of elements are 1; otherwise, they are 0. Arrange the elements in matrix R in the sequence according to their values:

0.83>0.81>0.76>0.75>0.74>0.73>0.63>0.58>0.57> 0.53

When ∫ = 0.83, the clustering class is: all the elements are 0. It is a unit matrix. It has the finest classification.

When∫ = 0.81, the clustering class is:
{2, 9}, {1, 3, 4, 5, 6, 7, 8, 10 and 11}
When ∫ = 0.76, the clustering class is:
{2, 7, 9}, {1, 3, 4, 5, 6, 8, 10 and 11}
When ∫ = 0.75, the clustering class is:
{2, 5, 7, 9}, {1, 3, 4, 6, 8, 10 and 11}
When ∫ = 0.74, the clustering class is:
{1, 2, 5, 7, 9}, {3, 4, 6, 8, 10 and 11}
When ∫ = 0.73, the clustering class is:
{1, 2, 5, 6, 7, 8, 9}, {3, 4, 10 and 11}
When ∫ = 0.63, the clustering class is:
{1, 2, 3, 5, 6, 7, 8, 9}, {4, 10 and 11}
When ∫ = 0.58, the clustering class is:
{1, 2, 3, 5, 6, 7, 8, 9, 10, 11}, {4}

When ∫ = 0.57, the clustering class is: all elements integrated into a class, which is the crudest class.

Seen from the result, the difference between 0.73 and 0.63 is big. And according to special characters of sprint, the strength of upper limbs and its explosive strength are vital important to improve the performances. Combining with Table 3, we can clearly see, the correlation coefficient between 8, 9 (jump and push barbell, snatch) and velocity strength, which is the only obvious factor of developing the strength of upper limbs. According to such, all the indexes can be classified into three types:

I class: V 2, V 9, V 7, V 5, V 1 are continuous hurdling jump, 30-meter squatting-distance starting run, 20 m timing single-foot jump, 50 m hurdling jump and frog jump. They have high relations with velocity strength. They can develop the explosive strength of lower limbs, strength of lower limbs and coordination of full body, etc. such method can develop the strength quality comprehensively. Therefore, we can call it as "class for comprehensively developing the velocity strength".

II class: V 6, V 8, which are jump and push barbell and snatch. According to sp special characters of sprint, the swing of two arms in the sprint is very important. It can not only sustain the body balance, but also help to accelerate the foot frequency and increase foot length. The pectoral girdle is the important premise for rapidly completing the front and back swing. Such class is the only one having obvious effects on upper limbs. Therefore, according to such qualities, we call it as "class for developing strength of upper limbs".

III class: V3, V 4, V10, V11, which are kettle boll squatting jump, weigh bearing extracting heel, weight bearing half squatting and weight bearing full squatting. Such class has low correlation coefficient with velocity strength. Their functions are mainly to develop the strength of lower limbs. We call it as "class for developing basic strength of legs".

CONCLUSION

With fuzzy mathematics, we can judge the correlation between factors of velocity strength and various training methods, conducting quantitative processing and analyzing in quantity, which has certain theoretic instructions for practical training. Relative analysis proves, the optimal organization of different training methods, can outstand the training specialization, saving training time and energy, so as to quantitatively control the training, improving the training efficiency. Due to the developing stages of boys, use various jumping practices, combining with traditional weigh bearing basic trainings, to develop their velocity strengths, which is valid, The various jumping practices can improve the explosive strength of heels and rapid contractility of muscles effectively.

As a leading thought and specific method, with mathematical methods, the analysis is scientific. Therefore, it should be spread in the trainings. Only by that can promote the study to exert its functions and stimulate it to develop towards scientific directions. As a complicate system, we should use advanced theoretic knowledge from many disciplines to study the main factors of special performances of athletes.

REFERENCES

Jing, Y., 2000. Application of fuzzy mathematical methods in sports. J. Shanxi Normal Sports College, vol. 15.

Li, H., 2000. Fuzzy Mathematical Basis and Practical Algorithm. Science Press, China.

Paavo, C., 1999. Strength and Rapid Strength in Sports. People Sports Press, Beijing.

Wang, B. *et al.*, 2011. Instructions of Competitive Sports Strength Training. People Sports Press, Beijing.

Wang, G., 2001. On the theory and methods of velocity strength training from the View of Cybernetics. J. Guangzhou Phys. Educ. Inst., 21(3).

Wang, P., 1998. Practical Fuzzy Mathematics. Huazhong University of Science and Technology, Wuhan.

Xie, J. and C. Liu, 2000. Fuzzy mathematical method and its application. Huazhong University of Science and Technology.