A STUDY OF THE RATE OF TORQUE BETWEEN UPPER
AND LOWER LIMBS OF MALE SPRINTERS

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In order evaluate the level in their strength development and to study the appropriate rate of torque among muscles at each joint so as to design criterion scientifically evaluating the magnitude of force, we assigned the subjects to four groups: male children (CHIL), male juveniles (JUVE), male juvenile sprinters from sports training school (JSTS), and young sprinters (YOSP). The flexors and extensor strength of their hip, knee, and shoulder joint are measured by an isokinetic test system. It is indicated in the result of the experiment the rate between high-speed strength and absolute strength of left and right knee extensors was lower than that of flexors. We have calculated and compared the relative torques of hip, knee, shoulder joint at the velocity of $60°/s$ using the relative peak torque of hip joint. Compared with CHIL, there was a significant increase in the knee average rate than that of shoulder in YOSP.

KEY WORDS: sprint, torque, isokinetic test, specified strength

INTRODUCTION: The paper is aimed at evaluating the development of athlete's specified strength, find the rate of torque between limbs to adjust the needs of sprint sports, and to develop an evaluation index of the specified strength. This research, through the basis of the entire body, measures the muscle torques at each joint between different ordinary children' ages and sprint athletes separately and explores the changing regularity of indices at different angular velocities so as to find if there is difference between the groups. The children (10 years old)can be adapted as a reference in order to seek the rate of coordinate joint muscles, especially the rational matching of dash athlete's upper and lower limbs. Furthermore, the study can offer the meaningful basic data and comparative materials in contrast to the characteristics of sprint athlete's joint muscular strength, and provides a basis for the evaluation index in measuring special strength scientifically. In this way, it is for the scientific training, serves to promote the sports achievement.

METHODS:
Experimental subjects: 10 boys(10 years old), 10 teenagers (15 years old), 10 juvenile sprinters from Youth Sports School, and male sprint athletes of track and field team of Hebei (18-20 years old) selected as subjects in this study.
Research approach: A Kinitech dynomometert (KEYLINK Company, Australia) was used to record muscular strength of the shoulder, hip, knee joints of each subject. The protocols of testing muscular strength according to Kinitech were followed strictly. Subjects warmed-up before testing at speeds of 60 °/s, 120 °/s and 240 °/s respectively. Warm-up exercises were used before testing and then every group flexes and extends 6 times at full strength at different speeds of testing. It took 30 seconds of interval at each time when tested at each speed.
The men selected who are experimented on must be conducted at same speed at the shoulder, hip, and knee joint skin group. It is established in angular speeds at (60 °/s, 120 °/s, 240 °/s), and is determined every joint and flexion/extensor and shrink the skin moment to the heart, peak value moment, ratio for peak value moment, ratio of flexion lasting peak value moment, calculating the ratio of joint strength (240 °/s) and absolute strength (60 °/s).
Methods Analysis: We used SPSS11.0 for Windows software to analyze the data. The statistics used were: average (Mean), standard deviation (SD), and Paired T-Test.

RESULTS:
Results and analasis on knee joint test of different groups: The test result indicates that for peak moment, relative peak moment of crooking the extensor of knee joint of every group gradually reduces with the increases of angular speed. This kind of variation tendency was in

accordance with relevant research report both at home and abroad. The tension of muscle is in agreement with the Hill equation muscle model theory that the speed is inversely proportional to torque.

The peak moment ratio of every group's knee joint flexion and extensor test gradually increased with angular speed. This indicates that the knee joint flexion strength drops slower than extensor strength as the tested speed increases. It proves that the knee joint crooks the skin adapts to the high speed of the heart work even better than the extensor does.

Analyzing the test result, peak moment of knee joint extensor and relative peak moment increases with the increasing age. The order is: Athlete's group > Group of sports school >Juvenile group > Children's group. The peak moment ratio of the extensor of knee joint of every group does not change with regularity.

When testing the relative peak moment about knee extensor at different speeds, it indicates that there is a difference between the children group relative peak moment and other group under various kinds of states. The difference appears to be obvious ($p < 0.01$). Comparing with the group of sports school of the same age and athlete's group, the juvenile group's relative peak moment has diversity in various kinds of test by speed under the states but is not significant at the $60°/s$ ($p > 0.05$). But at $120°/s$, the knee difference is highly significant to crook skin ($p < 0.01$). The left knee extensor difference is significant ($p < 0.05$), but the right knee extensor difference is not significant ($p > 0.05$). It proves that the sport training exerted an important influence and athlete's knee joint crooks the skin and adapts to the high speed to the heart to work even more than the extensor. The sport training and crooks skin influence on the knee is especially obvious and the sport training has a little effect on knee extensor. This reflects the training's weak point that strengthening the knee extensor training method means is studied and significant.

The average knee crook skin ratio is greater than extensor especially athletes. In addition, the order of crook knee joint fast strength skin/absolute strength ratio and extensor strength/absolute strength ratio: Athlete > Children's group >The group of sports school > juvenile group. The ratio of children's group is the result of natural growth, and the greatest athlete's difference is 149.2% and 131.1% respectively, It is the acquired result of training. Further explained, it should cause close attention to how to improve the fast strength of athlete's knee joint extensor.

Test results and analyzing on different group's hip joint: The test result indicates that peak moment, relative peak moment of crooking the extensor of hip joint of every group reduces gradually with the increase of the angular speed.

The children group is significantly difference from the sports school and athlete groups left hip extensor at $60°/s$ ($p < 0.05$); significantly different from the juvenile group's at $60°/s$ on the right hip crooks the skin ($p < 0.05$); and high significantly different on the right hip from the sports school group at $240°/s$ ($p < 0.01$). The juvenile group is different at $60°/s$, $120°/s$ and at $240°/s$. There is high significance on right hip crook skin and group's difference of sports school of the same age ($p < 0.01$) proving that the movement trains the function only when compared with athlete the group of sports school and has high significance on the right hip extensor in $120°/s$ and $240°/s$ ($p < 0.01$).

The ratio fast strength ($240°/s$) of hip joint and absolute strength ($60°/s$) reflects a group of relative percentage of fast strength and absolute strength of hip joint. It is an important index of appraising a group of strength development of hip joint. It is indicated in the result that the hip extensor ratio average is greater than crook skin especially that the extensor fast strength and absolute strength ratio of juvenile sports school and young men are greater than flexor muscle. The hip and crook the training for the fast strength of skin should be further strengthened. What merits attention is the ratios of the fast strength ($240°/s$) of hip joint of the children's group and absolute strength ($60°/s$). Although comparatively lower (crooks 76.16%, stretch 78.00%, crook 64.98%, stretch 65.94% in right in right on the left on the left) but the hip joint fast strength ($240°/s$) ratio and stretch ratio are relatively more ideal to crook with absolute strength ($60°/s$), 97.64%, 98.54% respectively, This is the result of the dynamic equilibrium formed naturally in the course of growing. But the athlete hip crook extensor ratio of fast strength and absolute strength are high (left crook 93.73%, left stretch

93.27%, right crook 93.29%, right deviation stretch 90.88%), hip joint fast strength (240 °/s) ratio and stretch ratio to crook with absolute strength (60 °/s) are100.49% and 102.65% respectively. Compared with children's group, it is in the course of training afterwards that a kind of high-level dynamic equilibrium is formed which proves the hip joint trains competence to be relatively high. Whether an athlete trains the dynamic equilibrium forming afterwards regardless or children dynamic equilibrium that group form naturally, they are all a kind of comparatively rational balance state. Comparatively, the juvenile group and sports school group did not do relatively good enough.

Results and analysis on different group's shoulder joint test: The test result indicates that the peak moment, relative peak moment of crooking the extensor of shoulder joint of every group increases as the angular speed reduces gradually.

Analyzing from the test result, the peak moment and the relative peak moment increases with the age as well as the shoulder joint and crooking the extensor in step. The order is: Athlete's group >Group of sports school >Juvenile group >Children's group.

When examining the relative peak moment in the different groups about shoulder extensor in different to test speed under the state. It shows that the relative peak moment of juvenile group is not significantly different at 60°/s and 120°/s test speeds but is different with sports school and athlete under the circumstances that various kinds of test the speed state (p<0.05 or p < 0.01). Compared with the sports school group of the same age, the right shoulder crooks the relative peak moment of extensor of juvenile group is highly significance under the circumstances that various kinds of test the speed state (p < 0.01) proving that training has an obvious influence on shoulder crook. Compared with the athlete group, the shoulder crook extensor relative peak moment of juvenile group is not different at 60°/s and 120 °/s test speeds but the difference is highly significance at 240 °/s (p < 0.01). Compared with athletes, the differences are not remarkable to students of sports school left shoulder crook extensor or right shoulder at 60 °/s, 120 °/s, and the 240 °/s. But in 240 °/s, the right extensor of shoulder is significantly different (p < 0.05). What merits attention is that at 240 °/s, both shoulder crook extensor and crook are significantly different.

Comparing shoulder joint fast strength (240 °/s) with absolute strength (60 °/s), the shoulder extensor ratio average is greater than the crook skin. The shoulder and crook training for the fast strength of skin should be further strengthened. We should especially pay attention that the ratio of the juvenile group crooks the fast strength of skin is lowest and the ratio of shoulder crook and fast strength of extensor and absolute strength of sports school and athlete the is higher than 90%. This shows that the training has exerted a good influence. The shoulder joint of about every group crooks the fast strength of skin (240 °/s)/absolute strength (60 °/s) Ratio and shoulder joint extensor fast strength (240 °/s)/absolute strength (60 °/s) percentage of the ratio relatively more rational, 98.35% and 94.39% respectively. But the athlete's percentage is the most rational (100.42% and 102.99% respectively), showing that training exerts an important influence on the athlete afterwards.

Test result contrast analysis taken, hip, and knee joint in different groups: According to the hip, knee, shoulder order, the relative peak moment situation of shoulder joint, every group of data, work out every hip, knee, ratio of the relative peak moment in 60 °/s of shoulder joint on a basis of hip joint, comparing with analyzing. Side crook skin of children group is respectively 1:0.62:0.32, 1:0.52:0.26; children extensor is 1:0 respectively group side not about 0.58:0.21, 1:0.52:0.26, crook skin respectively 0.5:0.23, 1:1.36:0.26. Group side extensor of juvenile 1:0 respectively 98:0.23,1:0.98:0.17; the sides crook skin of sports school group respectively 1:1.04:0.48, 1:1.08:0.51; side extensor of sports school group is respectively 0.27:0.78, 1:1.11:0.52; side crook skin of athlete group respectively 1:1.36:0.61, 1:1.24:0.38; side extensor of athlete group respectively 0.55:0.49, 1:1.07:0.32. For the above-mentioned ratio, the children's group for every joint side crook ratio of extensor comparatively close. It is a kind of comparatively rational ratio as a result of natural growth. The juvenile ratio of knee joint of group increases with age, approaching the ratio of the hip; Compared with juvenile group, the ratio about knee and shoulder joint of the youth sports school group at the same age is obviously higher than the ordinary juvenile group, proving that the movement trains on the knee and shoulder joint skin moment is obvious. Compared

with children's group, the ratio of the knee joint obviously increases, i as the age increases and the training level improves in the athlete's group, by 2.33 times equally. But compared with children's group the athlete's group ratio of the shoulder joint is of less increasing degree compared with the same period of last year, by 1.73 times equally, proving that the training level of group of shoulder joint skin remains to improve. What merits special attention is that compared with groups of sports school, the average ratio of athlete's knee joint increases by 18.00%, the average ratio of shoulder joint drops by 12%, proving that the athlete relatively pays attention to the muscle strength of low limbs to practice in the course of training, and neglect the training with muscle strength of shoulder We should pay close attention to it. So if you want to raise sport achievement, you must make improvement on the human body among dash sport, low limbs technology in step. While the special strength of low limbs improves, the special strength of upper limbs must get synchronous development. Though the human body, in the course of growing, the absolute strength of muscle have differences, to guarantee synchronicity of every body link and balance of human motion in order to adapt to the human body's coordination in fast running, we must develop every body link muscle strength in an all-round way. Thus, we can make every link muscle strength receive the balance development with omni-directional maximum. For this reason, to strengthen the scientific training of the muscle strength of upper limbs and shoulder, improving the ratio of the muscle peak of shoulder joint is of great necessity.

The fast strength of every joint/absolute strength ratio is to reflect a group of relative percentage of fast strength and absolute strength of every joint, and it is the important index to evaluate a group of strength development of every joint. By analysizing different group's fast force and absolute force of each group's hip, knees joint, we find every group about extensor of knee joint fast strength/absolute strength ratio average value is smaller than flexor muscle, especially the athlete and few group's differences of sports school are more obvious. This proves that training of extensor of the knee joint is relatively weak so we should especially pay attention to regular fast stretching the knee exercise. Every group's extensor of hip joint fast strength/absolute strength ratio was greater than flexor muscle. Children teenagers, in the course of growth, because there are more stretching and pedaling exercise in walking, running, jumping, and heavy loading relatively, these cause extensor fast strength/absolute ratio relatively heavy, especially the juvenile group's difference is relatively obvious. Sports school group and athlete group, in the course of training at ordinary times, stretching to pedal low limbs is more than flexor muscle, load of stretching exercise is heavier than flexor muscle as well. So, to promote the research of strengthening fast flexor muscle training, improving the hip and flexor muscle the fast strength/absolute strength ratio, are important ways of improving running speed, and therefore, we should put much emphasis to it.

CONCLUSION: The results show the rate between high-speed strength and absolute strength of left and right knee extensors is lower than that of flexors. We calculated and compared the relative torques of hip, knee, and shoulder joint at the velocity of 60 °/s using the relative peak torque of hip joint. Compared with CHIL, there was a significant increase in the knee average rate than that of shoulder in YOSP.

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