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## Mathematical statistical analysis-based China and America two countries middle school athletics development difference research

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### ABSTRACT

Middle school students' athletics sprint competitive abilities decide national sprint reserve force, develop middle school students' sprint competitive abilities is an important issue that current nation needs to confront. In order to look for targeted suggestions for Chinese middle school students' sprint training, the paper starts from China and America two countries middle school students' sprint each event championships performance during year 2004~2012, explores two countries differences, the purpose is to extract feasible suggestions on the basis of clear gap and make contributions to Chinese sprint reserve force expanding. In the paper, it uses progressive coefficient, fixed base growth coefficient and link-relative development coefficient as research variables, verifies reflected two countries competitive levels differences from championships performances, gets conclusion that during year 2004~2012 Chinese middle school students sprint performance has already developed from being slightly lower than American middle school students to being backward both in quality and quantity and had larger distances from America.

### KEYWORDS

Sprint event; Progressive coefficient; Fixed base growth coefficient; Link-relative development coefficient; Chinese and American differences.



## INTRODUCTION

For Chinese and American competitive sports levels differences research, many people have made efforts, which provide feasible suggestions for Chinese athletics sports and meanwhile also propel to Chinese competitive sports development process. Among them, Yuan Wen-Hui (2009) referenced American institution of higher learning competitive sports success experiences and scientific management methods, provided theoretical basis for establishing and perfecting universities competitive sports essence with Chinese characteristics, made comparative researches on China and America two countries institutions of higher learning competitive sports, and analyzed their management organizations, institution configuration, funds source, students sources and coaches status, found out Chinese institutions of higher learning competitive sports existing problems, got that it needed to absorb and reference American universities advanced ideas and mature experiences, combined with China's national conditions, and set out on a path of Chinese characteristics universities competitive sports development mode<sup>[1]</sup>. Chen Hui etc.(2013) explored Chinese universities high level sports team operation dilemma from participation impetus confusion, funds sources difficulties, talents orientations fatigue three aspects, compared Chinese and American universities high level sports teams operation mechanism from organizing mechanism, service mechanism and dynamic mechanism and other perspectives, and put forward corresponding countermeasures for Chinese current situations<sup>[2]</sup>. Yu Zhong-Tao etc.(2014) adopted documents literature investigation, mathematical statistics, comparative analysis method to make statistical analysis of year 2004-2012 China and America two countries middle school students athletics competition sprint top eight performances and athletes regional distribution, finally got Chinese middle school students men sprint well developed top three provinces Beijing, Jilin, and Hubei, middle school students women sprint well developed top three provinces and cities Hubei, Beijing and Sichuan, middle school students men and women sprint development trend presented regional nature and regional difference was very big such conclusions<sup>[3]</sup>.

The paper on the basis of formers research, studies and starts from sprint performance progressive coefficient, fixed base, link-relative development trend three parameters presented two countries championships differences, in the hope of getting two countries differences, and provides suggestions and references for targeted training.

## RESEARCH OBJECTS AND RESEARCH METHODS

Wu Ye-Hai etc.(2005) pointed out that national middle school students' athletics championships were hosted by Chinese middle school students' sports associations and Chinese athletics associations, were national highest level middle school students athletics competitions, in view of some significances, national middle school students' athletics championships could directly reflect a province, autonomous region, municipality middle school students' athletics competitive overall strength and level<sup>[4]</sup>. Tang Ji-Long etc.(2012) pointed out that Chinese athletics event's world high level events were quite little, reserve force was insufficient; overall athletics event group consciousness was weak<sup>[5]</sup>. Therefore, athletics level development status was related to Chinese sports reserve force, it should enlarge cultivation on reserve talents. In talents cultivation path exploration, firstly it should reference advanced levels countries cultivation modes, seek targeted strategies from differences, and then on the basis of summarizing differences, created cultivation modes. Chi Jian (2003) pointed out that America as world top athletics power, everlasting popular upmost basic link was teenage athletes cultivation that major in middle school students age group, in America, middle school students were cradle of excellent athletes

cultivation, by multiple forms voluntary developing early period sports training, built talents basis for developing competitive sports<sup>[6]</sup>.

### Research objects

The paper takes year 2004 to 2012 American middle school students athletics competition 100m, 200m, 400m running top performance, top three average performance and top eight average performance as reference objects, and takes year 2004 to 2012 Chinese middle school students' athletics competition 100m, 200m, 400m top performance, top three average performance and top eight average performance as research objects.

### Research methods

In the paper, it adopts documents literature, mathematical statistics and comparative analysis method, from which document literature searched Chinese knowledge net middle school athletics education relative literatures 10 pieces, Chinese excellent master and doctor thesis full text database and others relative performance analysis. Spring performance development trend, regional distribution features and others relative literatures, and by virtue of Baidu searching engine; in application of mathematical statistics method, it mainly adopts descriptive statistical method, use competitive performances to make quantitative analysis of China and America two countries middle school students athletics sprint development trend; in comparative analysis, it mainly targeted at China and America two countries middle school students athletics sprint competition performance progressive coefficient and sprint competition performance fixed base link-relative speed development trend.

## CORRELATION PARAMETERS CALCULATION METHOD

### Progressive coefficient

Progressive coefficient reflects every year middle school athletics competition sprint is in changing fluctuation rate; yearly progressive coefficient  $D$  calculation formula is as formula (1) shows:

$$D = \frac{Y - X}{X} \times 100\% \quad (1)$$

In formula (1),  $D$  represents progressive coefficient,  $Y$  represents the session performance,  $X$  represents last session performance.

The paper uses progressive coefficient average value that  $(\bar{X} \pm SD)$  to express event performance overall development level, variance  $S$  is used to reflect event performance development stability, in athletics competition events, it uses time to judge athletes' sports performance and ranking, is a low priority indicator, that is to say time interval gets smaller, performance will get better.

Therefore, when competition events progressive coefficient average value is negative, it shows the session performance is superior to last session performance, its absolute value gets larger, the advantage will get higher, when absolute value gets smaller, the advantage will also reduce, when average value is positive, it shows the session performance is inferior to last session performance.

### Fixed base growth coefficient

Fixed base growth coefficient reflection content is sports performance total growth speed in long period, its computational formula is as formula (2) shows:

$$Fd = \frac{Y - X}{Y} \times 100\% \quad (2)$$

In formula (2)  $Fd$  represents fixed base growth percentage coefficient,  $Y$  represent performance of year 2004,  $X$  represents progressive year performance.

Fixed base growth coefficient defines year 2004 performance as fixed base, if fixed base growth coefficient is above 0, then it shows progressive year performance has increased with respect to year 2004 performance, if fixed base growth coefficient is smaller than 0, then it shows progressive year performance has decreased with respect to year 2004 performance.

**Link-relative development coefficient**

Link-relative development coefficient reflection contents are sports performance growth speed by period, its computational formula is as formula (3) shows:

$$Fh = \frac{Z - W}{Z} \times 100\% \tag{3}$$

In formula (3)  $Fh$  represents link-relative growth percentage coefficient,  $Z$  represents last year performance,  $W$  represent current performance.

Link-relative dynamic figure can reflect performance fluctuation status, if link-relative growth coefficient is larger than 0, then it represents the session performance has promoted with respect to last session performance, if link-relative growth coefficient is smaller than 0, the it represents the session performance has declined with respect to last session performance.

**EMPIRICAL ANALYSIS**

**Data processing result**

As TABLE 1 shows year 2004 -2012 China and America national middle school students athletics championships sprint performances progressive coefficient status.

**TABLE 1 : Year 2004 -2012 China and America national middle school students’ athletics championships sprint performances progressive coefficient statistics**

Type		Top	Top three	Top eight
Chinese men	100m	-0.318 ± 1.415	-0.358 ± 1.559	-0.410 ± 1.530
	200m	-0.230 ± 1.010	-0.351 ± 0.883	-0.397 ± 1.340
	400m	-0.165 ± 0.588	-0.160 ± 0.443	-0.224 ± 1.715
Chinese women	100m	-0.467 ± 2.758	-0.481 ± 1.012	-0.383 ± 1.419
	200m	-0.107 ± 2.640	-0.017 ± 2.409	-0.040 ± 2.256
	400m	0.262 ± 1.171	0.091 ± 0.856	-0.074 ± 1.126
American men	100m	-0.730 ± 1.214	-0.663 ± 1.969	-0.716 ± 1.689
	200m	-0.726 ± 1.349	-0.686 ± 1.263	-0.743 ± 1.343
	400m	-0.877 ± 1.728	-0.735 ± 0.972	-0.716 ± 1.250
American women	100m	-0.930 ± 2.642	-0.952 ± 2.436	-1.038 ± 2.232
	200m	-0.892 ± 2.617	-0.904 ± 2.606	-1.012 ± 2.300
	400m	-0.979 ± 2.400	-1.035 ± 1.808	-1.148 ± 1.720

As TABLE 2 shows, China year 2004 to 2012 middle school students’ athletics championships fixed base growth coefficient status and link-relative development coefficient status.

As TABLE 3 shows China and America middle school students year 2004 athletics sprint championships performance and year 2004~2012 best performance comparison status.

As TABLE 4 shows, America middle school students surpass or flat with Chinese sprint performance number of people statistical status.

**TABLE 2 : China year 2004~2012 middle school students' athletics championships fixed base growth coefficient status and link-relative development coefficient statistical table**

Type		Men100	Men 200	Men400	Women100	Women 200	Women 400
Top fixed base growth coefficient	2005	0.010	-0.005	0.001	0.036	0.020	-0.001
	2006	0.024	0.020	0.001	0.049	0.030	-0.003
	2007	0.016	0.019	-0.001	0.027	0.019	-0.014
	2008	0.009	0.021	0.003	0.029	0.003	-0.016
	2009	0.015	0.026	-0.006	0.029	-0.020	-0.003
	2010	-0.006	0.022	0.004	0.035	0.031	-0.036
	2011	0.019	0.026	0.010	0.034	0.010	-0.019
	2012	0.027	0.019	0.012	0.038	0.010	0.020
Top three fixed base growth coefficient	2005	0.011	0.008	0.005	0.022	0.005	0.001
	2006	0.030	0.026	-0.001	0.033	0.025	0.001
	2007	0.011	0.025	-0.003	0.026	0.019	-0.004
	2008	0.016	0.027	-0.001	0.027	0.000	-0.012
	2009	0.026	0.033	-0.001	0.026	-0.025	0.000
	2010	0.007	0.025	0.002	0.025	0.019	-0.011
	2011	0.028	0.034	0.006	0.034	0.006	-0.004
	2012	0.029	0.029	0.012	0.037	0.003	-0.006
Top eight fixed base growth coefficient	2005	0.015	0.011	0.007	-0.001	-0.005	0.005
	2006	0.018	0.005	-0.001	0.033	0.027	0.013
	2007	0.010	0.024	-0.012	0.027	0.019	0.005
	2008	0.021	0.030	-0.012	0.028	0.004	-0.010
	2009	0.030	0.014	0.004	0.022	-0.015	0.008
	2010	0.005	0.021	-0.002	0.020	0.020	-0.001
	2011	0.029	0.040	0.011	0.029	0.010	0.004
	2012	0.032	0.031	0.019	0.030	0.005	0.006
Top link-relative development coefficient	2005	0.010	-0.005	0.001	0.037	0.020	0.000
	2006	0.011	0.025	-0.001	0.012	0.010	-0.001
	2007	-0.007	-0.001	-0.001	-0.022	-0.010	-0.010
	2008	-0.007	0.001	0.002	0.001	-0.015	-0.002
	2009	0.005	0.005	-0.010	-0.001	-0.023	0.013
	2010	-0.002	-0.003	0.010	0.007	0.050	-0.020
	2011	0.025	0.004	0.007	-0.001	-0.021	0.005
	2012	0.007	-0.008	0.001	0.005	0.000	0.000
Top three link-relative development coefficient	2005	0.011	0.008	0.005	0.022	0.005	0.001
	2006	0.019	0.019	-0.006	0.011	0.020	-0.001
	2007	-0.019	0.000	-0.003	-0.008	-0.005	-0.005
	2008	0.005	0.001	0.001	0.001	-0.020	-0.008
	2009	0.009	0.007	-0.001	-0.001	-0.024	0.011
	2010	-0.020	-0.009	0.005	0.000	0.044	-0.011
	2011	0.021	0.009	0.005	0.010	-0.013	0.009
	2012	0.000	-0.006	0.005	0.002	-0.002	-0.009
Top eight link-relative development coefficient	2005	0.015	0.011	0.006	-0.001	-0.005	0.005
	2006	0.004	-0.006	-0.008	0.034	0.031	0.010

2007	-0.006	0.020	-0.012	-0.006	-0.009	-0.010
2008	0.010	0.005	0.000	0.000	-0.013	-0.013
2009	0.009	-0.017	0.017	-0.005	-0.020	0.017
2010	-0.027	0.010	-0.023	-0.001	0.035	-0.008
2011	0.024	0.019	0.030	0.009	-0.010	0.006
2012	0.005	-0.009	0.007	0.001	-0.006	0.001

**TABLE 3 : China and America two countries middle school students' sprint performance comparison table**

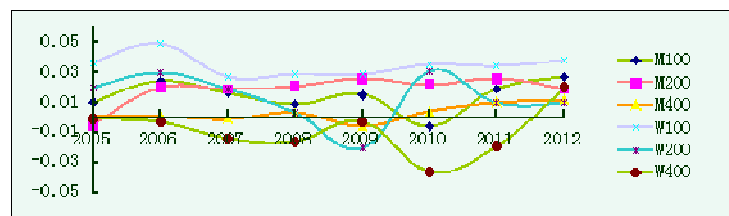
Type		Men100	Men 200	Men400	Women100	Women 200	Women 400
Top best in nine years of top 2004	China	10.85	22.05	48.4	12.45	25.12	55.76
	America	10.62	21.83	48.54	12.23	25.04	56.58
	China	10.57	21.49	47.76	11.85	24.35	55.76
	America	10.01	20.43	45.19	11.09	22.90	51.50
	China	11.16	22.69	49.54	12.62	25.68	57.86
	America	10.83	22.05	49.18	12.43	25.52	57.95
Top eight best in nine years of top eight 2004	China	10.79	21.78	48.60	12.20	24.99	57.09

**TABLE 4 : America middle school students surpass or flat with Chinese sprint performance number of people statistical table**

Type	Men100	Men 200	Men400	Women100	Women 200	Women 400
Chinese students record	10.57s	21.49s	47.76s	11.85s	24.30s	55.56s
2004year	0pcs	0pcs	0pcs	0pcs	0pcs	0pcs
2005year	0pcs	0pcs	1pcs	0pcs	0pcs	0pcs
2006year	12pcs	21pcs	11pcs	11pcs	15pcs	14pcs
2007year	20pcs	37pcs	17pcs	32pcs	27pcs	33pcs
2008year	51pcs	76pcs	41pcs	48pcs	50pcs	57pcs
2009year	74pcs	83pcs	48pcs	83pcs	73pcs	75pcs
2010year	67pcs	95pcs	37pcs	72pcs	77pcs	93pcs
2011year	82pcs	98pcs	50pcs	81pcs	69pcs	90pcs
2012year	111pcs	139pcs	74pcs	108pcs	3pcs	95pcs

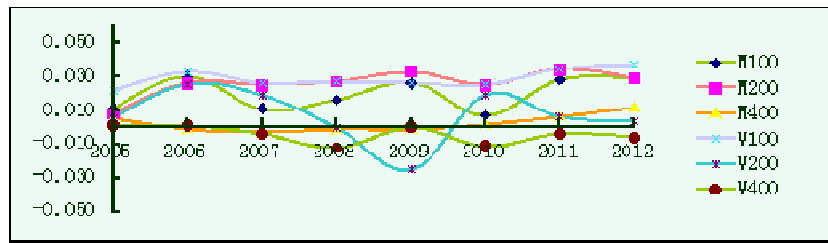
**Fixed base development trend and link-relative development trend result**

Chinese middle school students' athletics sprint championships each event top performance fixed base development trend is as Figure 1 shows.



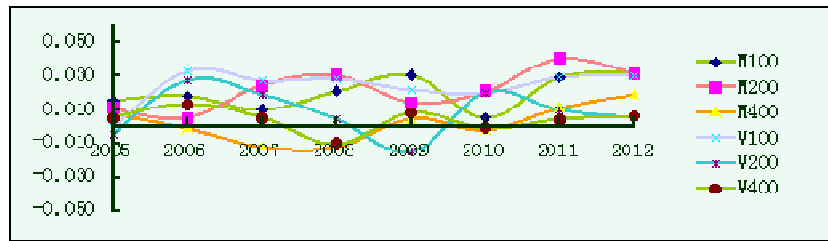
**Figure 1 : Chinese middle school students' athletics sprint championships each event top performance fixed base development trend schematic diagram**

Chinese middle school students' athletics sprint championships each event top three average performance fixed base development trend is as Figure 2 shows.



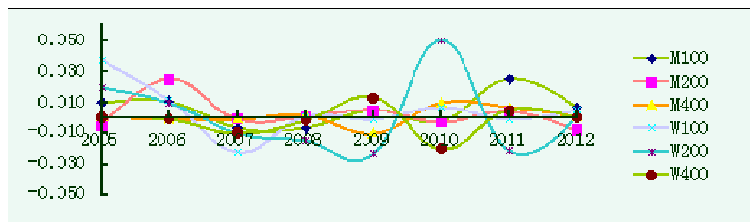
**Figure 2 : Chinese middle school students' athletics sprint championships each event top three average performance fixed base development trend schematic diagram**

Chinese middle school students' athletics sprint championships each event top eight average performance fixed base development trend is as Figure 3 shows.



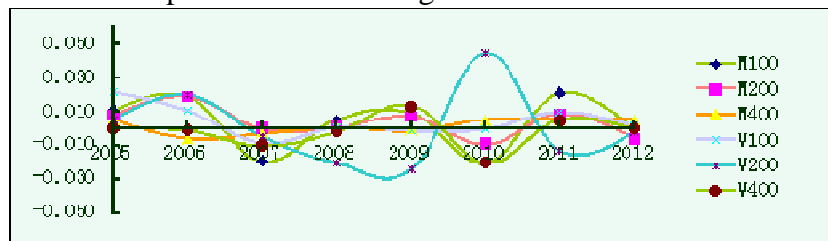
**Figure 3 : Chinese middle school students' athletics sprint championships each event top eight average performance fixed base development trend schematic diagram**

Chinese middle school students' athletics sprint championships each event top performance link-relative development trend schematic is as Figure 4 shows.



**Figure 4 : Chinese middle school students' athletics sprint championships each event top performance link-relative development trend schematic diagram**

Chinese middle school students' athletics sprint championships each event top three average performance link-relative development trend is as Figure 5 shows.



**Figure 5 : Chinese middle school students' athletics sprint championships each event top three average performance link-relative development trend schematic diagram**

Chinese middle school students' athletics sprint championships each event top eight average performance link-relative development trend is as Figure 6 shows.

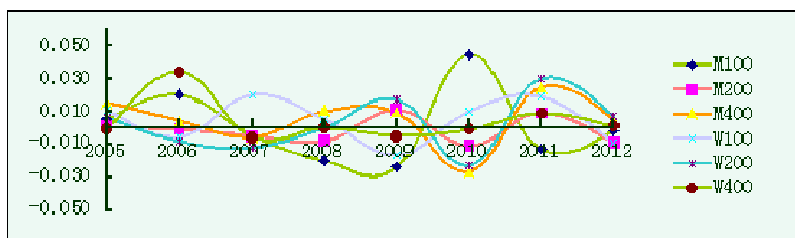


Figure 6 : Chinese middle school students’ athletics sprint championships each event top eight performance link-relative development trend schematic diagram

**Result analysis**

By TABLE 1, it gets conclusion as following shows:

1) Chinese middle school students athletics championships sprint performance women 400m running first performance progressive coefficient average value is 0.262, it proves women 400m running first performance is entirely in the sliding trend. Except for women 400m running first, other events first shows growing trend, from which first one growth trend maximum event is women 100m running. Women 400m running top three average performance progressive coefficient average value is 0.091, it proves that event shows sliding trend. Top three average performance lower coefficient average value growth order is women women100m>men 400m>men 200m>men 400m>women 200m>women 400m. All sprint events top eight average performances show performance growth development trend, fastest growing belongs to men100m running. First one performance stable development event is men 400m running, and men first all events development stability extent is higher than women first, top three average performance most stable event is men 400m running, top three average performance most unstable development event is women 200m running, top eight average performance most stable development event is women 400m running, top eight average performance most unstable development event is men 200m running.

2) American middle school students’ men and women sprint all events first performance, top three average performances and top eight average performance progressive coefficient average values, all are negative, it proves American middle school students athletics sprint event development status is superior to men sprint event, but has some gap with men in stability.

3) Men sprint progressive coefficient average values are larger than Chinese middle school students, from which men 100m running first performance progressive coefficient average value is nearly 2.3 times Chinese middle school students, men 100m running top three average performance and top eight average performance progressive coefficients average values are 1.8 times Chinese middle school students, other events also have different times superiorities. All American middle school students’ athletics women sprint progressive coefficients average values are also larger than Chinese middle school students.

4) Chinese middle school students’ men sprint event development status and stability are universally superior to women sprint events, and America is different from China in development status, but it has consistent performance with China in stability.

By TABLE 2 and Figure 1~Figure 6, it can get conclusions as following shows :

1) Men and women 100m running first performances are in the rising trend during year 2004~2006, and then in sliding trend in 2006~2007. Year 2005~2012 all men 400m running first performances are lower than performance in year 2004. Men 200m running first performances, except for year 2005 is lower than year 2004, all other years performances are higher than year 2004, and stable developing men 100m running first performances, except for year 2010 and women 100m running first performances are in the same development trends, during year 2005~2012 all 100m running performances are higher than year 2004 performances, and women 100m running first fixed base average growth range is 0.034, men 100m running fixed base average growth range is 0.014, is nearly 2.5 times men. Men 400m running first performances almost have no improvements during



year 2004~2008, keep stable development, and rapid promote during year 2009~2012. Women 200m running first performance fluctuation range is larger, development is not smooth.

2) Men 200m running top three average performances fixed base growth range in 2005~2006 two years basically the same as women 200m running top three average performances growth range, and all greatly increase in year 2004, but during 2007~2012 men still keep slow and small range fluctuation growth, and women have greatly fluctuation in these years and performances are also in the sliding trend. Men 100m running top three average performances fixed base development curve figure and women 100m running top three average fixed base development curve figure have same development trends, from which men 100m running top three average performances fixed base average growth range is 0.02, women 100m running top three fixed base average growth range is 0.029, is nearly 1.5 times men, and men fluctuation range is larger than women. All men 400m running top three average performances during 2006~2009 are lower than year 2004 top three average performances, during year 2010~2012, all men 400m running top three average performances are higher than year 2004 top three average performances and promote by year.

3) All men 200m running top eight average performances are higher than year 2004, and on a whole, they also are in the rising trend by year, but also appear twice performances valleys that are respectively in year 2006 and 2009. Men 400m running top eight average performances fluctuation range is larger, year 2006~2008, 2010 performances are lower than year 2004, until year 2011, 2012 performances then have larger promotions and promote by year, and arrive at peak in year 2006, after that it appears smaller fluctuation declination. All year 2005~2012 men 100m running top eight average performances are higher than year 2004 men 100m running top eight average performances, wholly present promotion trend by year, appear twice performances reduction are respectively year 2007 and 2010. Women 200m running and 400m running top eight average performance fixed base curve figure indicates larger fluctuation and unstable development.

4) Men 200m running first performance link-relative, top three average performance link-relative curves are basically the same, during year 2005~2007 fluctuation range is smaller. Men 100m running first performance link-relative, top three average performance link-relative, top eight performance link-relative development trend figure fluctuation curves are basically the same, year 2004~2006 performances development is relative smooth, year 2006~2012 performance fluctuation range is larger. Men 200m running top eight average performance link-relative is consistently in the larger range fluctuation, men 400m running first performance link-relative, top three average performance link-relative whole process is in a relative stable state, curve fluctuation range is small, it proves 400m running first performance and top three average performance development are relative smooth. Women 100m running first performance link-relative, top three average performance link-relative, top eight average performance link-relative development trend figure during year 2004~2008 fluctuation range is larger, performance development is unstable. Men 400m running top eight average performance link-relative curve fluctuation range is larger, performance development is unstable. In year 2008~2012, fluctuation range is smaller, it basically tends to stable.

5) On a whole, first performance link-relative figure fluctuation range maximum one is women 200m running event, performance most stable event is men 400m running, top 3 average performance most stable event is men 400m running, most unstable is women 200m running, top eight average performance all sprint events are in unstable states.

By TABLE 3 obtained conclusions are as following:

1) Chinese middle school students men and women 400m running first performance is superior to American middle school students in year 2004, men and women 100m running 200m running performances are round 0.2s lower than American middle school students.

2) By eight years development, select China and America two countries middle school students sprint best performances to make comparison, from which men 400m running performance is lower than America by 2.57s, women 400m running performance is 4.26s lower than America, men 100m running,

200m running are respectively 0.56s, 1.06s lower than America, women 100m running, 200m running are respectively 0.76s and 1.45s lower than America.

3) Year 2004 top eight average performances, only women 400m running performances are superior to America, from which men 100m, 200m, 400m running, women 100m, 200m running are respectively 0.33s, 0.64s, 0.36s, 0.19s and 0.16s lower than American middle school students, by eight years development, it selects year 2004~2012 top eight average performances best year to compare, men 100m, 200m, 400m running, women 100m, 200m, 400m running are respectively 0.62s, 1.02s, 2.34s, 0.85s, 1.86s and 4.3s lower than American middle school students.

By TABLE 4 obtained conclusion as following shows:

1) American middle school students' surpass, flat with men 100m running record performances 10.57s number of people has developed from zero people in 2004 to 111 people to 2012.

2) American middle school students' men surpass, flat with men 200m running record performance 21.49s number of people has developed from zero in 2004 to 139 people, and other events also have such development trend.

### CONCLUSION

The paper targeted at China and America two countries middle school students sprint each event championships process top performance, top three average performance and top eight average performance presented features in time to make research, makes comparative analysis of China and America two countries progressive coefficient, Chinese fixed base development state and Chinese link-relative development state. It gets conclusions as following show:

American middle school students men and women sprint progressive coefficient average value is superior to China, from which most fierce advantage is in American women 200m running top three average performance and top eight average performance progressive coefficient average value are respectively 53times and 25times Chinese middle school students.

On a whole, Chinese middle school students men sprint events development status and stable status are superior to women sprint events, and American middle school students sprint events development status is superior to men sprint events. And in development, Chinese sprint performances and American have larger distances.

Women 200m running top eight average performances and women 400m running top eight average performances development is unstable, fluctuation range is large. Chinese middle school students' women 100m running first performance fixed base development is 2.5 times men 100m running first performance fixed based development. Women 100m running top three average performance fixed base development is 1.5 times men 100m running.

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