*Available online www.jocpr.com*

**Journal of Chemical and Pharmaceutical Research, 2014, 6(7):984-990**

**Research Article**

**ISSN : 0975-7384**
**CODEN(USA) : JCPRC5**

# Chinese and foreign women heptathlon top athlete competitive ability features comparative research

**Yan Zhang[1*] and Yinmin Liu[2]**

[1]*Institute of Physical Education, Northeast Normal University, Changchun, Jilin, China*
[2]*Sports actuarial-oriented, Changchun University of Technology, Changchun, Jilin, China*

---

**ABSTRACT**

*The paper applies principal component analysis, studies on China's 12th National Games and the 30th Olympic Games women heptathlon competition result ranked top eight athletes result. It analyzes the differences of Chinese and world athletes each kind of sports events and its each individual sports event to total result contribution rate, studies on Chinese athletes and world athletes overall differences, and looks for Chinese athletes and world athletes total result improvement breakthrough points. Result shows that Chinese athlete should focus on training lower limbs strength, enhance Chinese athletes lower limbs explosive power so as to promote and intensify Chinese athletes speed type event and jumping type event advantages. Chinese athletes need to focus on development of 800m and javelin throwing events as Chinese athletes' total results improvements breakthrough points. Chinese athletes should put emphasis on their physical quality and psychological quality, develop Chinese athletes each kind of events in an all-round way to improve Chinese athletes results. While world top athletes should put emphasis on developing throwing events as their total results improvements breakthrough points. And meanwhile, world top athletes should also perfect speed kind and jumping kind sports events techniques so as to maintain their advantages of contribution rates to total results to consolidate their women heptathlon event overall advantages.*

**Key words:** Women heptathlon, principal component analysis method, 30thOlympic Games, 12th National Games, competitive ability

---

## INTRODUCTION

Women heptathlon event includes running ,jumping , and throwing three main sports events, is composed of 100m hurdle, high jump 、 shot put、200m、 long jump、 javelin throw and 800m as well as others seven individual events. Compares to world top athlete, Chinese women heptathlon highest result one's total result is 6750 points, and no matter in total result or in each individual sports event result, she keeps larger paces with world top athletes.

In order to enhance Chinese women heptathlon competition result, analyze Chinese women heptathlon athletes and world excellent athletes' differences, study on their each individual event sports result as well as individual sports event result and total result relations, domestic many scholars have made relative researches. Among them, Cai Li-Yan and others (2013)applied documents literature, mathematical statistics to study on women heptathlon sports features from the 23rd Olympic Games to the 30th Olympic Games, got that European and American women all-round players dominated, Chinese athletes should make all-round development in each individual event and other results and suggestions [1-5];Li Xin-Ying and others (2012)researched on China and world women heptathlon athletes competition results and techniques, by comparative analysis, they got the conclusion that China and world excellent athletes overall levels had larger differences [2-6]; Zhang Chuan-Min and others(2013)applied documents literature, comparative analysis and other methods so on , analyzed and researched on China and world top women heptathlon athletes total results and each individual event result ,got the conclusion that Chinese women heptathlon

event result declined, throwing, endurance kind events had obvious differences and else [3]; Zhang Yu-Lin and others(2013)applied documents literature, made statistics of the 30th Olympic Games women heptathlon top eight athletes competition results, and applied grey correlation method to analyze and research on total result and each individual event result relations, got the suggestions as paying attention to each event balanced development and synergetic development and else [4]; Xu Yan-Ping and others(2023)applied statistic eight excellent women heptathlon athletes results, established each individual event indicator relevance tree, made grey correlation analysis of them, and put forward suggestions that women heptathlon athletes should strengthen training on advantageous events and else [5-8].

The paper applied principal component analysis method, makes statistics and analysis of the 12th National Games and the 30th Olympic Games women heptathlon competition result top eight athletes results, and studies on China and world top athletes gap . By comparative analysis of National Games and Olympic Games women heptathlon competition result in each aspect, it provides references for improving China's competition results.

## WOMEN HEPTATHLON EVENT RESULT PRINCIPAL COMPONENT ANALYSIS

In order to analyze Chinese top athletes and world top athletes differences, the paper makes statistics of the 12th National Games and the 30th Olympic Games women heptathlon competition top eight athletes results, studies on China and world top athletes each individual event presented different features.

### *The 12th women heptathlon event result statistical analysis*

Principal component analysis can covert women heptathlon event each individual event indicator into few indicators so as to easy to research on Chinese excellent women heptathlon athletes levels and techniques as well as other features. In order to make principal component analysis, the paper does some processing with the 12th National Games competition total result and its each event sports result. For the 12th women heptathlon event competition result statistical data, it is as Table 1 shows.

**Table 1: National Games'top eight women heptathlon event competition results**

| Rank | Total points | 110m hurdle | High jump | Shot put | 200m | Long jump | Javelin throw | 800m |
|---|---|---|---|---|---|---|---|---|
| 1 | 5785 | 13.59 | 1.75 | 11.54 | 25.19 | 6.34 | 11.54 | 141.24 |
| 2 | 5580 | 13.54 | 1.69 | 11.42 | 25.28 | 5.91 | 11.42 | 141.42 |
| 3 | 5509 | 13.84 | 1.69 | 12.11 | 25.57 | 5.86 | 12.11 | 136.96 |
| 4 | 5454 | 14.23 | 1.75 | 12.10 | 27.13 | 5.71 | 12.10 | 148.05 |
| 5 | 5323 | 14.23 | 1.75 | 10.92 | 25.60 | 5.99 | 10.92 | 152.17 |
| 6 | 5320 | 15.10 | 1.75 | 12.37 | 27.00 | 5.47 | 12.37 | 144.91 |
| 7 | 5276 | 14.55 | 1.63 | 11.31 | 25.27 | 5.38 | 11.31 | 139.16 |
| 8 | 5256 | 14.53 | 1.66 | 11.37 | 25.79 | 5.52 | 11.37 | 137.34 |

In Table 1, statistical data is time, distance and so on, dimensions are not unified, it needs to make normalization processing with each individual event, unify each individual event result dimension so as to make principal component analysis of the 12th National Games women heptathlon athletes top eight athletes results. For high jump, shot put, long jump and javelin throw the four individual event , their statistical data gets bigger, and results would be higher, so take result ranked as top one event result as denominator, eight athletes results as numerator, calculate them [9-11]. For 110m hurdle、200m and 800m individual events, their statistical values get bigger than results become worse, so take top one athlete result as numerator, eight athlete results as denominator, calculate them. By above calculation, make normalization on statistical data, the result is as Table 2 shows.

**Table 2: National Games'top eight women heptathlon event competition results normalization result**

| Rank | 110m hurdle | High jump | Shot put | 200m | Long jump | Javelin throw | 800m |
|---|---|---|---|---|---|---|---|
| 1 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 2 | 1.0037 | 0.9657 | 0.9896 | 0.9964 | 0.9322 | 0.9896 | 0.9987 |
| 3 | 0.9819 | 0.9657 | 1.0494 | 0.9851 | 0.9243 | 1.0494 | 1.0313 |
| 4 | 0.9550 | 1.0000 | 1.0485 | 0.9285 | 0.9006 | 1.0485 | 0.9540 |
| 5 | 0.9550 | 1.0000 | 0.9463 | 0.9840 | 0.9448 | 0.9463 | 0.9282 |
| 6 | 0.9000 | 1.0000 | 1.0719 | 0.9330 | 0.8628 | 1.0719 | 0.9747 |
| 7 | 0.9340 | 0.9314 | 0.9801 | 0.9968 | 0.8486 | 0.9801 | 1.0149 |
| 8 | 0.9353 | 0.9486 | 0.9853 | 0.9767 | 0.8707 | 0.9853 | 1.0284 |

Carry out principal component analysis of after normalization National Games top eight women heptathlon event competition results, firstly it needs to calculate its correlation coefficient matrix, set women heptathlon athletes each event normalization results are respectively $x_i$ ,from which $i=1,2,\cdots,7$ .Then each individual sports event correlation

coefficient $r_{ij}$ can be solved by following formula:

$$r_{ij}=\frac{\sum_{k=1}^{n}(x_{ki}-\overline{x_i})(x_{kj}-\overline{x_j})}{\sqrt{\sum_{k=1}^{n}(x_{ki}-\overline{x_i})^2\sum_{k=1}^{n}(x_{kj}-\overline{x_j})^2}}$$

So that it solves correlation coefficient matrix that is composed of $r_{ij}$ :

$$R=\begin{bmatrix} 1.0000 & 0.0654 & -0.2467 & 0.5992 & 0.8113 & -0.2467 & 0.1664 \\ 0.0654 & 1.0000 & 0.2938 & -0.4858 & 0.5271 & 0.2983 & -0.7371 \\ -0.2467 & 0.2983 & 1.0000 & -0.6942 & -0.2303 & 1.0000 & 0.1159 \\ 0.5992 & -0.4858 & -0.6942 & 1.0000 & 0.4196 & -0.6942 & 0.4433 \\ 0.8113 & 0.5271 & -0.2303 & 0.4196 & 1.0000 & -0.2303 & 0.1911 \\ -0.2467 & 0.2983 & 1.0000 & -0.6942 & -0.2303 & 1.0000 & 0.1159 \\ 0.1664 & -0.7373 & 0.1159 & 0.4433 & -0.1911 & 0.1159 & 1.0000 \end{bmatrix}$$

For correlation coefficient matrix, it calculates and solves its feature value $\lambda_i$ and feature vector $e_i$ ,it solves seven feature values, from which there are three feature values that are larger than 1 as $\lambda_1=3.1857,\lambda_2=2.1443,\lambda_3=1.4294$ ,and their corresponding feature vectors are respectively :

$e_1=[0.3566\ \ -0.2167\ \ -0.4775\ \ 0.5282\ \ 0.2705\ \ -0.4775\ \ 0.1331]^T$
$e_2=[-0.2946\ \ -0.6175\ \ -0.0005\ \ 0.0984\ \ -0.5377\ \ -0.0005\ \ 0.4828]^T$
$e_3=[0.4781\ \ -0.0475\ \ -0.4335\ \ 0.1561\ \ 0.2965\ \ -0.4335\ \ 0.5301]^T$

Principal component $z_i$ contribution rate can be solved by formula $\lambda_i/\sum_{k=1}^{n}\lambda_i$ ,it solves that feature value $\lambda_1,\lambda_2,\lambda_3$ corresponding $z_1,z_2,z_3$ contribution rates are respectively 0.7671,0.1303,0.0545,their accumulative contribution rate is 0.9519. For principal component analysis method, generally take principal components that accumulative contribution rates arrive at 85～95% ,so it selects three principal components $z_1,z_2,z_3$ .

Principal components $z_1,z_2,z_3$ component loading can be solved by formula $p(z_k,x_i)=\sqrt{\lambda_k}e_{ki}$ ,from which $x_1,x_2,\cdots,x_7$ respectively represent 110m hurdle、high jump、shot put、200m、long jump、 javelin throw and 800m seven sports events. It solves three principal components loading matrix, thereupon it can solve three principal components loading factor matrix as Table 3 shows.

**Table 3: National Games results principal components loading factor matrix**

| | $x_1$ | $x_2$ | $x_3$ | $x_4$ | $x_5$ | $x_6$ | $x_7$ |
|---|---|---|---|---|---|---|---|
| $z_1$ | 0.6365 | -0.3868 | -0.8523 | 0.9428 | 0.4828 | -0.8523 | 0.2376 |
| $z_2$ | -0.4313 | -0.9042 | -0.0007 | 0.1441 | -0.7874 | -0.0007 | -0.0707 |
| $z_3$ | 0.5761 | -0.0568 | -0.5183 | 0.1866 | 0.3545 | -0.5183 | 0.6338 |

***The 30th Olympic Games women heptathlon event result principal component analysis***

By processing with statistic the 30th Olympic Games women heptathlon competition result, the paper studies on each individual event to its total result contribution rate, and studies on world athletes competitive strength. The 30th women heptathlon top eight athletes' competition results are as Table 4 shows.

**Table 4: Olympic Games top eight women heptathlon event competition result**

| Rank | Total points | 110m hurdle | High jump | Shot put | 200m | Long jump | Javelin throw | 800m |
|---|---|---|---|---|---|---|---|---|
| 1 | 6955 | 1195 | 1054 | 813 | 1096 | 1001 | 812 | 984 |
| 2 | 6649 | 1086 | 1016 | 845 | 908 | 943 | 894 | 957 |
| 3 | 6628 | 1053 | 978 | 805 | 1013 | 1020 | 788 | 971 |
| 4 | 6618 | 1087 | 1016 | 787 | 1012 | 946 | 853 | 917 |
| 5 | 6599 | 978 | 1132 | 1016 | 848 | 927 | 882 | 816 |
| 6 | 6576 | 1130 | 978 | 811 | 913 | 890 | 974 | 880 |
| 7 | 6480 | 1178 | 830 | 848 | 1047 | 822 | 778 | 977 |
| 8 | 6452 | 1069 | 1016 | 845 | 937 | 915 | 738 | 932 |

Do normalization processing with Table 4 statistic competition result, its initialization method is the same as National Games competition result processing method, due to Table 4 each event competition result is counted in the form of scores, so take total result ranking top one athlete competition result as denominator, eight athletes results as numerator, calculate them. It can get initialization processing obtained result as Table 5 shows.

**Table 5: Olympic Games top eight women heptathlon event competition result normalization result**

| Rank | 110m hurdle | High jump | Shot put | 200m | Long jump | Javelin throw | 800m |
|---|---|---|---|---|---|---|---|
| 1 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 2 | 0.9088 | 0.9639 | 1.0394 | 0.8258 | 0.9421 | 1.1010 | 0.9726 |
| 3 | 0.8812 | 0.9279 | 0.9902 | 0.9243 | 1.0190 | 0.9704 | 0.9868 |
| 4 | 0.9096 | 0.9639 | 0.9680 | 0.9234 | 0.9451 | 1.0505 | 0.9319 |
| 5 | 0.8184 | 1.0740 | 1.2497 | 0.7737 | 0.9261 | 1.0862 | 0.8293 |
| 6 | 0.9456 | 0.9279 | 0.9975 | 0.8330 | 0.8891 | 1.1995 | 0.8943 |
| 7 | 0.9858 | 0.7875 | 1.0431 | 0.9553 | 0.8212 | 0.9581 | 0.9929 |
| 8 | 0.8946 | 0.9639 | 1.0394 | 0.8549 | 0.9141 | 0.9089 | 0.9472 |

By Table 5 data, it can solve the 30th Olympic Games top eight women heptathlon competition result correlation coefficient matrix, its matrix R is as following shows:

$$R=\begin{bmatrix} 1.0000 & -0.5913 & -0.6230 & 0.7457 & -0.2168 & -0.1054 & 0.6726 \\ -0.5913 & 1.0000 & 0.4880 & -0.4612 & 0.5627 & 0.2689 & -0.5718 \\ -0.6230 & 0.4880 & 1.0000 & -0.6380 & -0.2012 & 0.1212 & -0.6970 \\ 0.7457 & -0.4612 & -0.6380 & 1.0000 & 0.2048 & -0.5145 & 0.7897 \\ -0.2168 & 0.5627 & -0.2012 & 0.2048 & 1.0000 & -0.0912 & 0.1966 \\ -0.1054 & 0.2689 & 0.1212 & -0.5145 & -0.0912 & 1.0000 & -0.5533 \\ 0.6726 & -0.5718 & -0.6970 & 0.7897 & 0.1966 & -0.5533 & 1.0000 \end{bmatrix}$$

For solved correlation coefficient matrix, it calculates and solves its feature value and corresponding feature vector , from which feature values maximum three feature values are $\lambda_1 = 3.7162$, $\lambda_2 = 1.5480$, $\lambda_2 = 0.9864$.The three feature values corresponding feature vectors are respectively:

$e_1 = [0.4306 \ -0.3724 \ -0.4084 \ 0.4644 \ -0.0031 \ -0.2568 \ 0.4769]^T$

$e_2 = [-0.2009 \ 0.4796 \ -0.1084 \ 0.1876 \ 0.7783 \ -0.2227 \ 0.1654]^T$

$e_3 = [-0.2985 \ -0.1241 \ 0.4341 \ 0.0251 \ -0.1960 \ -0.8133 \ 0.0806]^T$

**Table 6: Olympic Games results principal components loading factor matrix**

| | $x_1$ | $x_2$ | $x_3$ | $x_4$ | $x_5$ | $x_6$ | $x_7$ |
|---|---|---|---|---|---|---|---|
| $z_1$ | 0.8301 | -0.7179 | -0.7873 | 0.8952 | -0.0060 | -0.4950 | 0.9193 |
| $z_2$ | -0.2500 | 0.5967 | -0.1349 | 0.2334 | 0.9684 | -0.2771 | 0.2058 |
| $z_3$ | -0.2965 | -0.1233 | 0.4311 | 0.0249 | -0.1947 | -0.8087 | 0.0801 |

Three feature vectors corresponding principal components contribution rates are respectively 0.5309,0.2211,0.1409.The three accumulative contribution rate is 0.8929,its value is between 85%～95% , so can process the 30th Olympic Games women heptathlon competition each individual event result into three principal components, three principal components $z_1, z_2, z_3$ loading matrix, thereupon it can solve three principal

components loading factor matrix as Table 6 shows.

**CHINESE AND FOREIGN WOMEN HEPTATHLON COMPETITION RESULTS COMPARATIVE ANALYSIS**

***The 12th National Games women heptathlon event results analysis***

National Games represent Chinese top athletes' strength. By above analysis ,it is clear that the paper selected three principal components in 12th women heptathlon results descriptive information respectively occupies 76.71%,13.03%,5.45% of total information,due to solved three principal components loading are orthogonal, so the information that three principal components can totally describe is 95.19% of total information. According to solved the 12th National Games women heptathlon event loading matrix, three principal components can be expressed by following formulas:

$$F_1 = 0.6365x_1 - 0.3868x_2 - 0.8523x_3 + 0.9428x_4 + 0.4828x_5 - 0.8523x_6 + 0.2376x_7$$
$$F_2 = -0.4313x_1 - 0.9042x_2 - 0.0007x_3 + 0.1441x_4 - 0.7874x_5 - 0.0007x_6 - 0.0707x_7$$
$$F_3 = 0.5761x_1 - 0.0568x_2 - 0.5183x_3 + 0.1866x_4 + 0.3545x_5 - 0.5183x_6 + 0.6338x_7$$

According to women heptathlon event features, the paper divides seven individual events into speed factor, jumping factor, strength and endurance factor. In the three principal component, the first principal component's larger loading variables are shot put and 200m event, their loading values are larger than 0.8. In the second principal component, variables with larger loading values are 100m hurdle, high jump and long jump, all their loading values are larger than 0.4, the two events that have larger loading values in the third principal component are javelin throw and 800m, their loading values are larger than 0.5. Therefore, it is clear that for domestic top women heptathlon athletes, shot put and 200m have largest impacts on them, secondly is 100m hurdle、high jump and long jump, the smallest ones are javelin throw and 800m. Among them, shot put and 200m respectively belong to technical strength factor and speed factor, 100m hurdle、high jump and long jump respectively belong to speed factor and jumping factor, javelin throw and 800m respectively belong to technical strength factor and endurance factor.

Above analysis shows that Chinese women heptathlon athletes 800 event scoring rate is lower, endurance is worse, 800m can be taken as their results emphasis of breakthrough, and focus on its training. Except for shot put, events that affect Chinese athletes results are successively 200m ,110m hurdle, high jump and long jump, the former two belong to speed factor, the latter two belong to jumping factor, the four are related to explosive power, it can strengthen athletes lower limbs strength training in future training.

Secondly , by above analysis ,it is clear that shot put loading amount is the largest, in order to ensure Chinese women heptathlon athletes results, it needs to strengthen shot put event competition result advantages, and ensure shot put event score proportion. For javelin throw that similarly belongs to throwing type event, its proportion in Chinese athletes competition results is the smallest one, which can be used as breakthrough sports event for Chinese athletes results, shot put and javelin throw similarly belong to technical strength type factor, therefore, it is clear that strengthen Chinese athletes scores in throwing event is an important orientation for Chinese athletes results improvements, Chinese women heptathlon athletes should on the basis of perfecting throwing type sports techniques, strengthen relative each kind of physical quality and psychological quality training. Finally is Chinese athletes 800m event , Chinese athletes 800m event loading in the seven individual events is smaller, only is slightly bigger than javelin throw event. 800m event belongs to endurance type factor, its requests on each aspect of athlete surely are different from that of speed kind and jumping kind sports events. Chinese athletes should focus on training athlete lower limbs strength explosive power, put emphasis on enhancing speed explosive power related speed type event and jumping type event competition results, which surely will impact 800m event training and result improvement. So for Chinese women heptathlon athletes 800m event training, take its performance has no big differences with other individual events as primary, no need to ask too much on its performance.

***The 30th Olympic Games women heptathlon event result analysis***

Olympic Games represent world top athletes' results. By above analysis ,it is clear that the paper selected three principal components in the 30th Olympic Games women heptathlon seven individual events by principal component analysis, the three descriptive information respectively occupies 53.09%、22.11% and 4.09%of total information, the three principal components totally describe 89.29% of total information. According to solved loading matrix of the 30th Olympic Games women heptathlon, three principal components and seven individual events relations can be expressed by following formulas:

$$F_1 = 0.8301x_1 - 0.7179x_2 - 0.7873x_3 + 0.8952x_4 - 0.0060x_5 - 0.4950x_6 + 0.9193x_7$$
$$F_2 = -0.2500x_1 + 0.5967x_2 - 0.1349x_3 + 0.2334x_4 + 0.9684x_5 - 0.2771x_6 + 0.2058x_7$$

$$F_3 = -0.2965x_1 - 0.1233x_2 + 0.4311x_3 + 0.0249x_4 - 0.1947x_5 - 0.8087x_6 + 0.0801x_7$$

By above expressions, it is clear that in the first principal component, larger loading amount individual sports events are 110m hurdle、200m and 800m event, all their loading values are larger than 0.8, which respectively belong to speed factor and endurance factor. In the second principal component, larger loading amount individual sports events are high jump and long jump, both loading values are larger than 0.5,both the two belong to jumping factor. In the third principal component , larger loading amount individual sports events are shot put and javelin throw, their loading values are larger than 0.4, both the two belong to strength factor. Thereupon, it is clear that for world top women heptathlon athletes, their strength and competition result influential orders are strictly following the rank of speed factor, endurance factor , jumping factor and strength factor, the structure shows relative clear.

By the 30th Olympic Games women heptathlon result analysis, it is clear that for world top athletes, speed type event has largest impact on them; these athletes are mainly from Europe and America. Reasons for Olympic Games women heptathlon event competition result appears such structure is mainly related to physical quality, Asian and other players are difficult to compete with European players in speed type and endurance type sports events. In speed kind and endurance kind events, European and American players only need to perfect their techniques and maintain their psychological quality in speed kind events then European and American world athletes can easily to keep advantages. For long jump and high jump such two jumping events, it doesn't ask too much for lower limbs explosive power, European and American players also have certain advantages. European and American players can perfect the two events techniques, improve their competition results. For European and American players, shot put and javelin throw the two throwing type events are the third principal components, their loading amounts are also lower, which has smallest contribution rates on their total results, so can focus on training the two as breakthrough points of improving their total results. In technical perfection of shot put and javelin throw, meanwhile they should also focus on their physical quality and psychological quality training.

For world women heptathlon athletes, their training emphasis in order is throwing type event, jumping type event and speed as well as endurance event. For jumping type event, key points is their technical perfection, for throwing type event, they should perfect their techniques and also focus on their physical quality and psychological quality training.

***Chinese and foreign women heptathlon event results comparative analysis***

In order to research and analyze Chinese top athletes and world top athletes differences and gap, the paper makes statistics of the 12th National Games and the 30th Olympic Games women heptathlon top eight athletes total results, the result statistics is as Figure 1 shows.

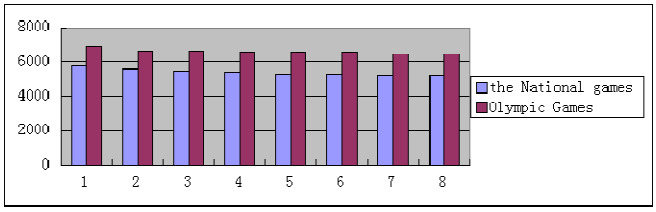


**Figure 1: National Games and Olympic Games women heptathlon top eight athletes total results**

By Figure 1, it is clear that China's National Games top eight athletes results have above 1000 scores gap with Olympic Games women heptathlon top eight athletes' results by comparing. Chinese 12th National Games women heptathlon top eight athletes average score is 5437.9 scores,and the 30th Olympic Games top eight women heptathlon athletes average result is 6619.6 scores,is 1181.7 scores higher than the 12th National Games average result that is 21.73% higher, Chinese women heptathlon athletes keep considerable paces with world women heptathlon athletes by comparing.

Women heptathlon event is a complex system, it should keep self advantageous individual event advantages and meanwhile put emphasis on breaking through weak sports events, make all-round development on each individual event so that can really improve their total results. By above analysis ,it is clear that importance order of each kind of events that affect Chinese women heptathlon athletes total results are roughly as speed kind event, jumping kind event, throwing kind event and endurance king event. Importance order of each kind of events that affect world top women heptathlon athletes' total results are speed kind event, endurance kind event, jumping kind event and throwing kind event. For China and world top athletes, speed kind event and jumping kind event have larger impacts on total results. Comparing to Chinese athletes, world top women heptathlon athletes physical quality has great advantages, for speed kind event and jumping kind event, mainly should perfect their techniques and carry on

psychological quality training,while for Chinese athletes ,except for perfecting techniques and carrying on psychological quality training, training their physical quality still comes first. Javelin throw event in jumping type is Chinese top athletes and also world top athletes weakest event; it can simultaneously be used as key objects of Chinese and world athletes' development. And meanwhile, Chinese athletes can focus on developing 800m sports event to let Chinese athletes' total results to have a breakthrough.

Compare to world top athletes, Chinese athletes each kind of sports individual sports event to total result contribution rank is not clear, in throwing type event, shot put and javelin throw results to total results contribution rate respectively rank in the first and last one, thereupon, Chinese athletes technical level hasn't reached the peak of perfection, it still has considerable big dev elopement space. Perfect Chinese athletes each kind of sports events techniques are key points to improve Chinese athletes' results.

## CONCLUSION

For Chinese top women heptathlon athletes results, their each kind of sports event result to total result contribution rate size are roughly ranking as speed kind event, jumping kind event, throwing kind event and endurance king event . World top women heptathlon athletes results, their each kind of events ranking is clear as speed kind event, endurance kind event, jumping kind event and throwing kind event. And Chinese athletes each kind of event individual events to total result contribution rate ranking is not adjacent, which shows Chinese athletes each kind of event techniques are to be perfected.

For Chinese athletes and world athletes each kind of sports event ranking, though only is different in endurance kind event, world top athletes physical quality has larger advantages by comparing to Chinese athletes, they mainly should perfect their techniques and carry on psychological quality training. And for Chinese athletes, except for perfecting techniques and carrying on psychological quality training, training their physical quality still comes first. And meanwhile both Chinese athletes and world athletes should look for breakthrough in javelin throw event. Chinese athletes also should focus on training800m sports event to shorten Chinese and world top athletes gap. Chinese athletes should still intensify their lower limbs strength training to improve and maintain their contribution advantages to Chinese athletes' total result in speed kind event and jumping kind event.

## REFERENCES

[1] WU Shao-ming ,ZHOU Zhi-jie. *Journal of Wuhan Institute of Physical Education*, **2001**, 35(4), 93-94.
[2] CHEN Xue-mei. *Bulletin of Sport Science & Technology*, **2007**, 15(6), 22-23,43.
[3] LAN Zheng. *Sport Science And Technology*, **2008**, 29(1), 58-60.
[4] ZHONG Da peng ,ZHANG Xin yun. *Journal of Wuhan Institute of Physical Education*, **2002**, 36(5), 50-51.
[5] HU Qi. *Journal of Physical Education Institute of Shanxi Teachers University*, **2004**, 19(1), 90-92.
[6] ZHAO Zhong-hua. *Journal of Shenyang Sport University*, **2003**, (3), 44-46.
[7] Zhang B.; Zhang S.; Lu G.. *Journal of Chemical and Pharmaceutical Research*, **2013**, 5(9), 256-262.
[8] Zhang B.; *International Journal of Applied Mathematics and Statistics*, **2013**, 44(14), 422-430.
[9] Zhang B.; Yue H.. *International Journal of Applied Mathematics and Statistics*, **2013**, 40(10), 469-476.
[10] Zhang B.; Feng Y.. *International Journal of Applied Mathematics and Statistics*, **2013**, 40(10), 136-143.
[11] Bing Zhang. *Journal of Chemical and Pharmaceutical Research*, **2014**, 5(2), 649-659.