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Talking about the Influences of Height and Technique for Obtain the Rebound on the Basketball Game

--------Based on Men's Basketball Matches of 29th Olympic Games

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Abstract. This study attempts to quantitatively analyze the factors about players' height and rebounding techniques, researching into the effects of heights and skills on securing rebounds. The result indicates that the number of rebounds that teams whose average height of power forwards and centers is low get is fewer than that number of rebounds teams whose average height of power forwards and centers is middle and tall get, and because of the little necessity of point guards and shooting guards participating in rebounds, the Regression Coefficient and Correlation Coefficient of team members are comparatively low. In the team whose average height is low but power guards and shooting guards are relatively technically high, the technical superiority can make up the weakness of the heights. In addition, the team which is not dependent on height but still does well in the competition is superior over other teams in terms of the technical value. Therefore, besides height, techniques can also be one of the dominant factors of securing rebounds. Taking these two factors into account thoughtfully the power of the team can be estimated objectively and effectively.

Key Words: rebound; height; technique

1. Foreword

Basketball is a fiercely competitive sport. In the offensive-defensive change, both teams try their best to increase their own offensive times and restrict the other's for the purpose of higher scores. So it is acknowledged that obtaining more offensive times, which is also called the possession of the ball, plays an important role in winning the game. Securing rebounds is known as the core in the possession of the ball by professional. As we know, although the advantage of height is an important factor in snatching rebound, there are other factors affecting the number of rebound, such as the body of the control, bounce, defensive position, opportunities, and judge techniques and so on. So far, there have been many researches about rebound in China, but most of them mix up the height and techniques and their results obviously can't s explain the problem. If we can separate height and techniques to research about securing rebound and quantitatively analyze the factors, the power of the team can be estimated more objectively and effectively.

An Analysis of the Basketball Games on the Height and Techniques of Men's Team in Olympic Games as objects, attempt to separate height and techniques to research and quantitatively analyze them to discuss how height and techniques influence the rebound for the purpose of offering the reference for Chinese basketball training, especially the techniques of securing rebound.

2. the research object

10 matches, 7 teams and 84 players of 2008 Beijing Olympic Games are objects in this study and choose six of preliminary contests by height difference. Additional 4 matches are semi finals and the final without height difference. I separately compare starters of each team according to corresponding position that is divided according to the international standards, PG (point guard), SG (shooting guard), SF (small forward), PF (power forward) and C (center).

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Table 1 According to height choice 6 competitions

Height	Low VS Middle	Middle VS Height	Height VS Low
VS	ANG VS USA	ARG VS ESP	SCG VS ANG
VS	IR VS ARG	USA VS SCG	ESP VS IR

Table 2 Not according to height choice 4 competitions（Semi-final, finals）

Competitions	**Semi-final play1**	**Semi-final play2**	**Competition for 3&4**	**final**
VS	ESP VS LTU	USA VS ARG	ARG VS LTU	USA VS ESP

3. research methods

This study uses quantitative method as follows.

3.1. Weighing number acquisitions of height and rebound of pull-out time

Changing players is frequent because of situation changes in a match. Different player has different pull-out time, but no matter how many times a team changes player, 5 players need attend a match, meanwhile each team has 200 minutes pull-out time. So it is necessary to calculate average height and acquisitions rebound of each team after weighing pull-out time.

$$\bar{i} = \frac{1}{200}\sum_{i=1}^{12} lifi \tag{1}$$

$\bar{i}$ =Average height after weighing pull-out time

li =height of players

fi =pull-out time of players

$$\bar{R} = \frac{1}{200}\sum_{i=1}^{12} Rifi \tag{2}$$

$\bar{R}$ =The average rebound number after weighing pull-out time

Ri =the rebound acquisitions of players

3.2. Variance

It is based on above data that we calculate the variance of height (σ_i^2) and rebound (σ_R^2) and covariance of rebound (σ_{iR})

$$\sigma_l^2 = \frac{1}{200}\sum_{i=1}^{12} l_i^2 fi - \bar{l}^2 \tag{3}$$

$$\sigma_R^2 = \frac{1}{200}\sum_{i=1}^{12} R_i^2 fi - \bar{R}^2 \tag{4}$$

$$\sigma_{lR} = \frac{1}{200}\sum_{i=1}^{12} liRifi - \bar{l}\cdot\bar{R} \tag{5}$$

3.3. Correlation coefficient

Calculate standard deviation of around regression line（σm）, then get the correlation coefficient（p）. Standard deviation of around regression line（σm） indicates the situation of data dispersion.

$$\sigma_m = \sqrt{\sigma_R^2 - \frac{\sigma_{lR}^2}{\sigma_l^2}} \quad (6)$$

$$\rho = \frac{\sigma_{lR}}{\sigma_l \sigma_R} \quad (7)$$

3.4. Regression coefficient

Calculate regression coefficient according to regression line（m_i）.

$$m_i = \frac{\sigma_{lR}}{\sigma_l^2} \quad (8)$$

In addition, calculate the average of regression coefficient of 10 matches' scores

$$\bar{m} = \frac{1}{20}\sum_{i=1}^{20} m_i \quad (9)$$

Calculate the average of standard deviation because of discrepancy around regression line

$$\bar{\sigma}_m = \frac{\sqrt{1}}{20}\sum_{i=1}^{20} \sigma_m^2 \quad (10)$$

3.5. Techniques

Based on data on regression line, different height players have a ideal value of securing rebound, the ideal value divided by real value is technical value (W).

$$W = \frac{\text{Actual Value}}{\text{Ideal Value}} \quad (11)$$

3.6. The rebound ratio coefficient

According to height difference, calculate rebound ratio, which can reflect that personal height gives opponents pressing index.

$$V = \frac{m}{2\bar{R}}\gamma + 1 \quad \gamma = \text{Height Difference} \quad (12)$$

4. Results and analysis

4.1. Analysis according to height difference

4.1.1 Low teams (IR, ANG) and middle teams (ARG, USA)

Table 3 IRvsARG The first round lineup's rebound number, the technique, the rebound ratio coefficient

Team	IR			Team	ARG		
	R	W	V		R	W	V
180（PG）	6	1.26	0.88	182（PG）	3	1.05	0.96
190（SG）	3	0.64	0.99	198（SG）	5	1.56	1.10
190（SF）	4	0.83	0.63	202（SF）	2	0.59	1.02
210（PF）	4	0.63	1.02	208（PF）	1	0.26	1.00
218（C）	3	0.83	1.07	211（C）	7	1.74	1.03

Table 4 ANGvsUSA The first round lineup's rebound number, the technique, the rebound ratio coefficient

Team	ANG			Team	USA		
	R	W	V		R	W	V
185（PG）	2	1.49	0.71	194（PG）	1	0.56	0.85
190（SG）	2	1.11	0.79	194（SG）	3	1.25	0.94
192（SF）	1	0.53	0.98	203（SF）	2	0.42	1.04
201（PF）	0	0.00	1.15	206（PF）	5	0.93	1.12
202（C）	3	1.11	1.16	211（C）	7	1.15	1.20

Table 5 IRvsARG, ANGvsUSA Projects computed result

	$\bar{l}$	$\bar{R}$	σ_l	σ_R	m_i	σ_m	p
IR	198.92	3.80	9.49	1.70	0.02	2.89	0.09
ARG	198.75	3.23	8.20	1.95	0.05	3.63	0.20
ANG	193.26	2.05	5.71	1.47	0.08	1.96	0.30
USA	200.41	4.31	8.23	2.11	0.13	3.22	0.52

$0.7 \leqq P \leqq 1.0$ obvious relation, $0.4 \leqq P < 0.7$ relation, $0.2 \leqq P < 0.4$ quite relation，$0 < P < 0.2$ no relation

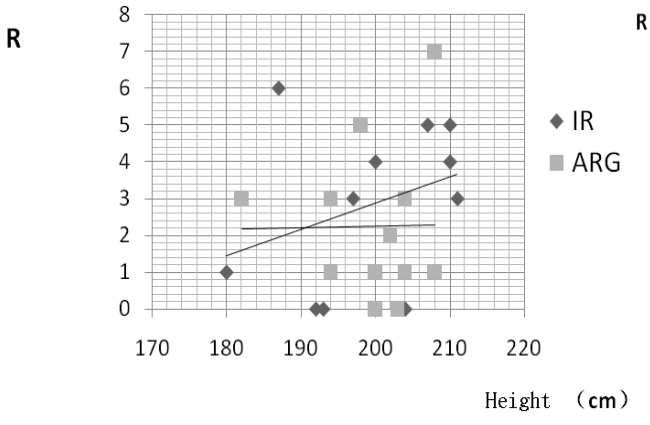

Fig 1 IRvsARG The relational graph about the height and the rebound's numbers

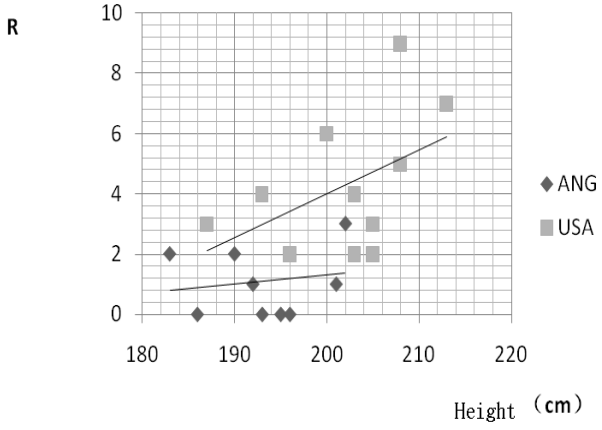

Fig 2 ANGvsUSA The relational graph about the height and the rebound's numbers

Data shows that PG and SG of IR and ANG are better than their opponent on techniques, especially both countries' PG are on the top of the list, respectively 1.26 and 1.49. Centers of middle teams get high scores on techniques and rebound number. In fact, Howard, the American center, plays basketball in NBA as PF. He is outstanding on rebounding techniques. Both IR and ARG have low value, respectively m_i=0.02, 0.09; m_i=0.05, 0.20, it indicates that there is no obvious relation between height and the rebound number in both teams, so we can see they are both good at rebounding techniques. However, P=0.52 (USA) shows that the rebound number relates to height, in other words, players who are tall obtain more rebounds. Otherwise, from regression lines of graph 1 and graph 2, we can see that height difference is no relationship to players' position, but there is relationship between height difference and the rebound number. Data of the USA is concentrated on the upper right and tall players acquire more rebound numbers, so the USA is a team that depends on tall players to secure rebound. On the contrary, the rebound number is average in ANG and we cannot see height difference influences obtaining rebound so that almost every player on the field takes part in securing rebound.

4.1.2 Middle stature teams (ARG, USA) and tall stature teams (SCG, ESP)

We can see from table 4 and table 5 that there are some players whose W is 1.00 in tall teams. It states that technical value of starters of both teams. Although two players are the same height, techniques plays an essential role in obtaining rebound from the low value of PF in ARG, W=0.31. The same problem also happened in the match, height difference is merely 3cm, but the gap of technical values of two teams is wide. On the other hand, that high values of the USA(P=0.71) and ESP (P=0.56) from table 6 indicates that tall players apparently have advantages of securing rebounds. Table 3 shows that data of SCG concentrates on

the left. Although SCG has a 2.16m high center, he does not have any advantages on rebound.

Table 6 ARGvsSCG The first round lineup's rebound number, the technique, the rebound ratio coefficient

Team	ARG			Team	SCG		
	R	W	V		R	W	V
182（PG）	0	0	0.06	200（PG）	2	1.00	1.73
198（SG）	5	2.28	0.98	203（SG）	5	1.25	1.03
202（SF）	2	0.70	1.03	206（SF）	3	0.68	1.10
208（PF）	1	0.31	1.14	208（PF）	12	2.08	1.14
211（C）	6	1.86	1.14	216（C）	0	0	1.22

Table 7 USAvsESP The first round lineup's rebound number, the technique, the rebound ratio coefficient

Team	USA			Team	ESP		
	R	W	V		R	W	V
194（PG）	4	6.00	0.77	191（PG）	1	0.71	0.74
194（SG）	1	0.63	0.72	200（SG）	3	1.15	0.96
203（SF）	2	0.42	1.09	204（SF）	4	1.08	1.00
206（PF）	5	0.97	1.20	207（PF）	8	1.06	1.16
211（C）	9	1.34	1.20	215（C）	7	1.27	1.32

Table 8 ARGvsSCG, USAvsESP Projects computed result

	$\bar{l}$	$\bar{R}$	σ_l	σ_R	m_i	σ_m	p
ARG	199.90	2.80	7.22	1.94	0.10	3.29	0.36
SCG	202.75	4.07	6.81	3.06	0.18	7.79	0.41
USA	199.28	4.26	10.59	2.92	0.20	4.25	0.71
ESP	202.63	3.66	5.65	1.95	0.19	2.59	0.56

$0.7 \leqq P \leqq 1.0$ obvious relation，$0.4 \leqq P < 0.7$ relation，$0.2 \leqq P < 0.4$ quite relation，$0 < P < 0.2$ no relation

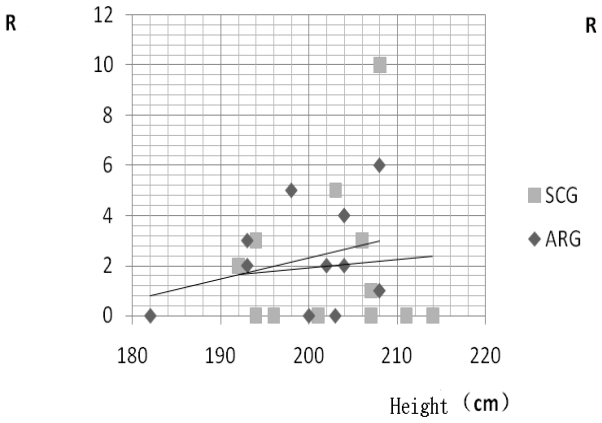

Fig 3 SCGvsARG The relational graph about the height and the rebound's numbers

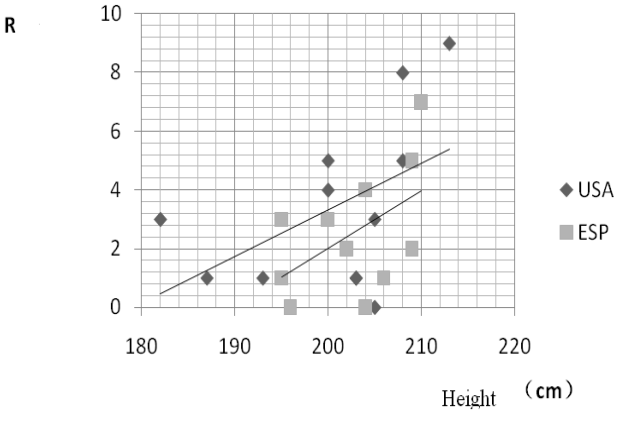

Fig 4 USAvsESP The relational graph about the height and the rebound's numbers

4.1.3 low stature teams (IR, ANG) and tall stature teams (SCG, ESP)

Table 9 IRvsSCG The first round lineup's rebound number, the technique, the rebound ratio coefficient

Team	IR			Team	SCG		
	R	W	V		R	W	V
180（PG）	2	1.38	0.62	200（PG）	2	1.18	1.67
190（SG）	0	0.00	0.87	203（SG）	1	0.40	0.99
200（SF）	5	1.35	1.05	206（SF）	4	0.85	1.14
210（PF）	3	0.75	1.20	208（PF）	4	0.75	1.16
218（C）	5	1.15	1.39	216（C）	3	0.41	1.25

Table 10 ANGvsEPS The first round lineup's rebound number, the technique, the rebound ratio coefficient

Team	ANG			Team	ESP		
	R	W	V		R	W	V
185（PG）	5	1.47	1.08	191（PG）	1	1.00	0.67
190（SG）	6	1.63	1.12	200（SG）	4	2.68	0.72
192（SF）	0	0.00	0.97	204（SF）	3	0.75	1.07
201（PF）	4	3.52	0.78	207（PF）	5	1.22	1.30
202（C）	3	2.22	0.75	215（C）	8	1.31	1.34

Table 11 IRvsSCG,ANGvsESP Projects computed result

	$\bar{l}$	$\bar{R}$	σ_l	σ_R	m_i	σ_m	p
IR	199.14	2.59	10.14	1.74	0.10	2.06	0.56
SCG	201.41	4.06	6.75	3.71	0.31	9.98	0.52
ANG	193.92	2.47	5.75	1.83	-0.13	2.56	-0.47
ESP	202.35	3.81	5.50	2.51	0.43	2.79	0.82

$0.7 \leqq P \leqq 1.0$ obvious relation，$0.4 \leqq P < 0.7$ relation，$0.2 \leqq P < 0.4$ quite relation，$0 < P < 0.2$ no relation

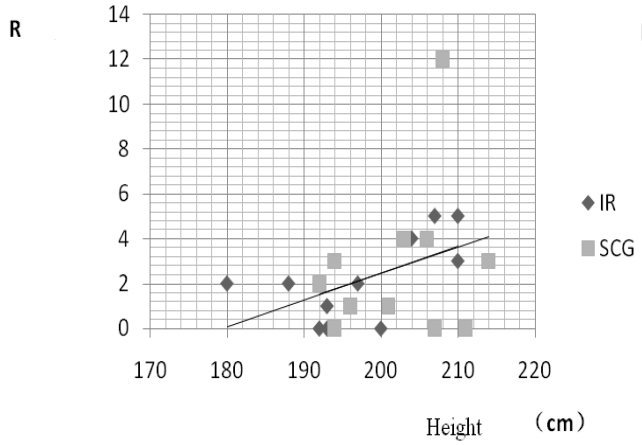

Fig 5 The relational graph about the height and the rebound's numbers

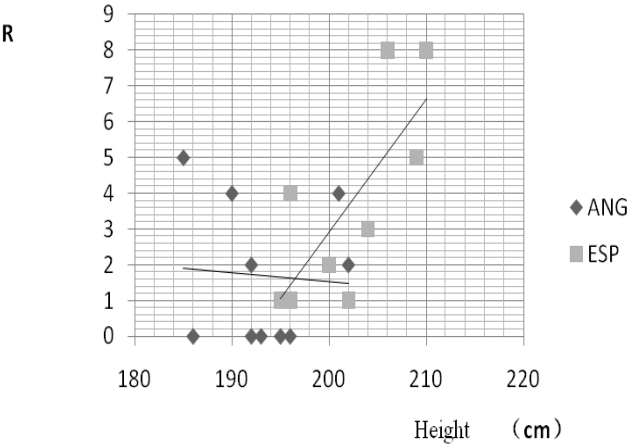

Fig 6 ANGvsESP The relational graph about the height and the rebound's numbers

Data shows that technical values of PG, SF, and C in IR are all over 1.10 evidently surpass the same position players' values in SCG. Values of PG, SG, PF, C in ANG are more than 1.10, especially PF (w=3.52) and C (w=2.22), which indicates that both IR and ANG who are low teams are outstanding at techniques of securing rebound, which makes up for lowage in height. Otherwise, high stature teams, SCG and ESP, respectively m_i=0.31, m_i=0.43, shows that height has notable effect on the rebound number, and σ_m=9.98 of SCG displays a big dispersal degree. On the aspect of correlation coefficient, p=0.82 of ESP, the high value, shows that tall stature players have apparent advantages on rebound. But on the other hand, m_i=-0.13,p=-0.47 of ANG displays that the rebound number that low players get are more than that tall players do. From graph 6, we can also get the same conclusion.

4.2. The competition analyzes without height difference

Table 12 ESPvsLTU The first round lineup's rebound number, the technique, the rebound ratio coefficient

Team	ESP			Team	LTU		
	R	W	V		R	W	V
191（PG）	5	1.67	0.85	192（PG）	5	0.95	0.98
200（SG）	4	1.14	1.06	198（SG）	5	0.96	0.91
204（SF）	2	0.43	1.02	201（SF）	0	0.00	0.98
207（PF）	5	0.85	1.06	209（PF）	3	0.94	1.03
215（C）	9	1.53	1.17	211（C）	5	1.73	0.87

Table 13 ARGvsUSA The first round lineup's rebound number, the technique, the rebound ratio coefficient

Team	ARG			Team	USA		
	R	W	V		R	W	V
182（PG）	2	0.84	0.74	194（PG）	2	0.71	0.99
198（SG）	3	0.86	0.96	194（SG）	1	0.27	0.71
202（SF）	5	1.05	1.05	203（SF）	2	0.32	1.11
208（PF）	4	0.67	1.24	206（PF）	8	1.31	1.20
211（C）	8	1.11	1.20	211（C）	8	1.15	1.27

Table 14 LTUvsARG The first round lineup's rebound number, the technique, the rebound ratio coefficient

Team	LTU			Team	ARG		
	R	W	V		R	W	V
192（PG）	1	0.63	0.98	182（PG）	4	0.85	0.80
198（SG）	1	0.53	0.86	198（SG）	6	1.07	0.98
201（SF）	4	1.54	0.96	202（SF）	9	1.43	1.04
209（PF）	2	0.51	1.02	208（PF）	11	1.62	1.07
211（C）	4	1.02	1.24	211（C）	3	0.42	1.14

Table 15 ESPvsUSA The first round lineup's rebound number, the technique, the rebound ratio coefficient

Team	ESP			Team	USA		
	R	W	V		R	W	V
191（PG）	1	0.56	0.86	194（PG）	1	-6.67	0.95
200（SG）	2	0.45	0.95	194（SG）	0	0.00	0.62
204（SF）	5	1.21	1.04	203（SF）	2	1.06	1.03
207（PF）	4	0.83	1.05	206（PF）	7	1.17	1.30
215（C）	8	1.94	1.51	211（C）	6	1.13	1.46

Table 16 ESPvsLTU,ARGvsUSA,LTUvsARG,ESPvsUSA Projects computed result

	$\bar{l}$	$\bar{R}$	σ_l	σ_R	m_i	σ_m	P
ESP	200.40	5.60	10.46	2.05	0.12	2.46	0.65
LTU	202.33	5.10	8.69	2.11	-0.06	4.19	-0.25
ARG	200.97	4.54	7.51	1.52	0.16	0.77	0.82
USA	201.3	5.13	10.47	2.92	0.22	3.41	0.77
LTU	199.90	3.50	9.10	1.68	0.09	2.02	0.53
ARG	200.42	6.36	7.13	3.50	0.18	10.55	0.37
ESP	200.22	3.38	7.21	1.52	0.09	1.86	0.64
USA	201.82	5.04	10.57	3.29	0.26	3.11	0.84

0.7≦P≦1.0 obvious relation，0.4≦P<0.7 relation，0.2≦P<0.4 quite relation，0<P<0.2 no relation

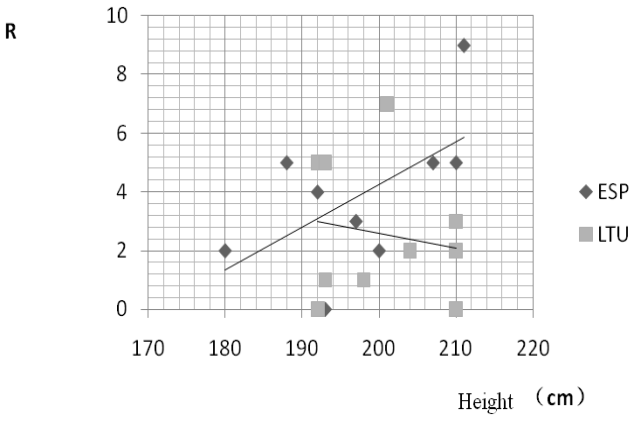

Fig 7 LTUvsESP The relational graph about the height and the rebound's numbers

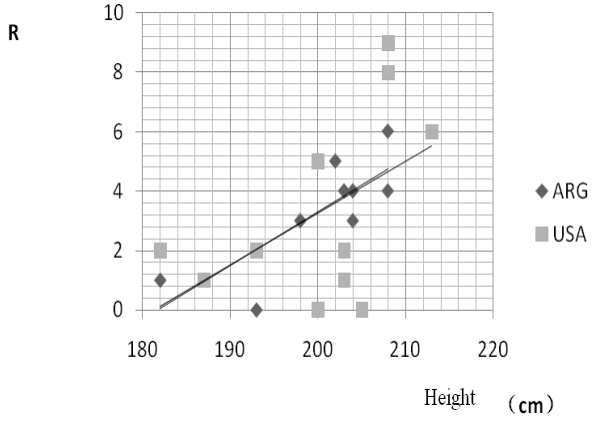

Fig 8 ARGvsUSA The relational graph about the height and the rebound's numbers

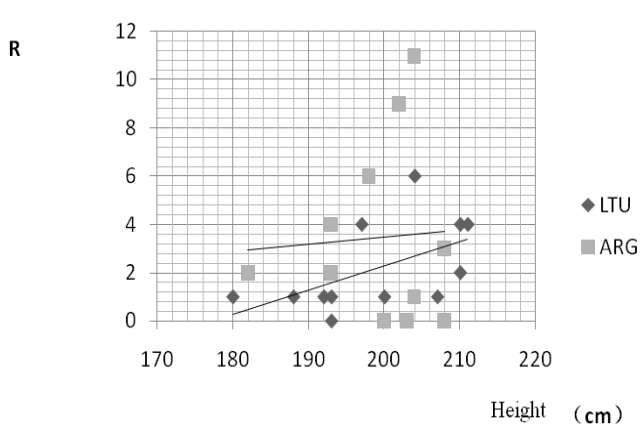

Fig 9 LTUvsARG The relational graph about the height and the rebound's numbers

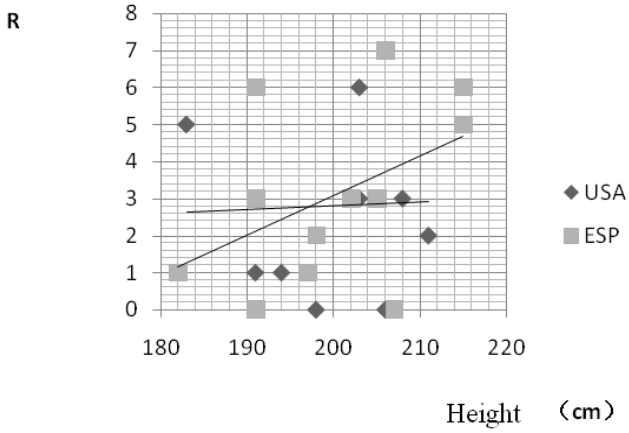

Fig 10ESPvsUSA The relational graph about the height and the rebound's numbers

The graphs show that the average height of above four teams are close, except starting PG and SG, the other positions do not have remarkable difference. Most technical values of four teams are more than or nearly the ideal value in the above formulas; therefore, we can think that the percentage that depends on techniques to obtain rebound is quite high. In the semifinal, USA VS ARG, the average height of both teams is close, but technical values of starters in ARG are higher than that in USA. Although USA won the match, total rebound numbers of ARG are more than those of USA. From the match video we can see that more rebound numbers give ARG a big advantage. In the final, USA VS ESP, five of starting 10 players' W are over 1, particularly C of ESP reaches W=1.94. In addition, table 14 displays that P of 4 teams are generally high, which indicates that high rebound numbers depend on tall players. Data of graph 7, 8 and 9 concentrate on the right and it evidently shows that tall players are main force to secure rebound. It can be seen that tall height difference is still an important factor that affects the rebound number.

4.3. The analyzes about 10 competitions

Table 17 10 competitions, 84person's computed results

	$\bar{l}$	$\bar{R}$	$\overline{m_i}$	$\overline{\sigma_m}$	p
$\overline{N}$	200.26	4.36	0.13	3.77	0.54

0.7≦P≦1.0 obvious relation，0.4≦P<0.7 relation，0.2≦P<0.4 quite relation，0<P<0.2 no relation

From table 15, the average height of 84 players is 200.26cm, and the average rebound number is 4.36. $\overline{m_i}$ =0.13 means that every 1cm height difference leads to 0.13 rebound number difference according to the above formula. Correlation coefficient is 0.43, which indicates that there is a correlation between height difference and the rebound number. It can be seen from above graphs that players who are from 195cm to 205cm are main force to secure rebounds; therefore, SF, PF and C are main positions to obtain rebounds.

5. Conclusion

1. It is showed in the conclusion that technical values of teams that the average heights are low are relatively high. However, in real matches, the necessity of the rebound participation of PG and SG is not essential. The rebound acquisition depends on PF and C. Both positions of low teams compared with positions of middle and high teams, the rebound acquisition number is a low value, so the regression coefficient and the correlation coefficient in teams are low.

2. It is showed that the correlation coefficient in 10 matches is 0.54.There is the correlation in height difference and the rebound acquisition number.

3. In the team whose average height is low but power guards and shooting guards are relatively technically high, the technical superiority can make up the weakness of the heights. Therefore, taking these two factors into account thoughtfully the power of the team can be estimated objectively and effectively.

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