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A study on the time-space differentiation of medals in the 1951-2018 Asian Games

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Abstract

To reveal the time-space differentiation mechanism of the medals obtained by the participating countries of the Asian Games and the spatial evolution pattern of the Asian Games medals over time, the statistics of the medals won from the 1st New Delhi Games in 1951 to the 18th Jakarta Asian Games in 2018 were carried out. Use the Moran'I index and the LISA cluster map to explore the spatial relationship of medals obtained by participating countries in the Asian Games. The research results show that the process of hosting the Asian Games can be divided into the first period of exploration (1951-1966); the second period of gradual formation (1966-1978); the third period of rapid development (1978-1986); the fourth period of stability The development period (1986-2018) has 4 stages. Among them, the spatial autocorrelation of the Asian Games medals peaked in paragraph 3, but paragraph 4 showed a trend of sports-specific monopoly, leading to unbalanced competition. It is recommended that the Asian Olympic Council and other relevant institutions solve it as soon as possible to maintain the balance of competition and ensure competitive sports. The event is developing steadily.

1 Introduction

Analyzing the spatial distribution pattern of sports undertakings by studying the distribution of medals can provide a scientific basis for relevant decision-making agencies (departments) to make reasonable decisions. Taking the 27th Olympic Games as an example, Ronghua.Xie used statistical analysis and literature research to study the medal acquisition situation of track and field events and found that Europe, North America, Latin America and Africa are the main gathering places of Olympic medals (Ronghua.Xie 2001). Yang.Su's research on the differentiation of medals in the 29th Olympic Games found that the proportion of medals won by sports powers is on a downward trend (Yang.Su 2009). Garcia-del-Barrio.P assigns the corresponding weights of gold, silver, and bronze to the Olympic medals. The number of searches on the Internet and the changes in tracking time are studied to create a national historical ranking showing relevant changes (Garcia-del-Barrio.P 2020). Jin-ming.Zhang used the Herfindahl-Hirschman Index to analyze the distribution of medals in the 1988-2016 Olympic Games and World Championships and found that China is dominant in both events (Jin-ming.Zhang 2018) . The differentiation of Olympic medals between provinces in China is also different, especially the slow development of sports in Northwest China (Chun-Yu.Liu 2019). It can be seen that the research on the distribution of medals has attracted the attention of scholars, providing different methods, theories and perspectives for subsequent research. However, the research of many scholars takes the Olympic Games, the World Championships and certain events as the mainstream viewpoint, and has not paid attention to the Asian Games. Since 1951, the Asian Games have been hosted by the member countries

of the Asian Olympic Council in turn, and a total of 18 sessions have been held in 2018. During this period, the number of participating events, participating countries, and athletes continued to increase. The Olympic culture, Olympic spirit, and Olympic declaration The continuous promotion and development of Asia has also formed an Asian competitive sports competition model, which has promoted the vigorous development of Asian sports and sports industry, and formed an Asian competitive sports economic system around the continuous holding of the Asian Games.

Of course, the spatial location of "Asia" and "Olympic Council member states" should belong to the category of geography. According to Tobler's first law of geography: real world events almost never obey perfect spatial random or independent random processes, in other words , Everything has a spatial correlation, but things that are closer are more relevant than things that are far away, which is spatial autocorrelation (Souris. M 2019). In recent years, geographic information systems have gradually been applied to the research of sports science, and the spatial distribution and spatial pattern of sports careers have gradually attracted the attention of scholars. Therefore, the author uses the Moran'I index and the LISA cluster map to explore 1951-2018 The spatial autocorrelation and dynamic evolution of the distribution of Asian Games medals to reveal the spatial connection of the Asian Games medals among the international. While presenting the history of the Asian Games medal distribution, it is expected to provide scientific and reasonable guidance for relevant agencies (departments) to formulate competition balance policies for the Asian Games.

2 Methods

2.1 Data collection

Taking the number of medals obtained by participating countries in the Asian Games as the data statistics object, weighted sums (5 points for gold medals, 3 points for silver medals, and 2 points for bronze medals) are given weights according to the level of medals to calculate the comprehensive scores of the Asian Games medals of each participating country. All medals since the 1st New Delhi Games in 1951 come from Baidu Baike (https://baike.baidu.com). It is worth mentioning that in the 2018 Jakarta Asian Games, the medals won by the Korea-Korea Alliance will be 50% owned. It is included in the comprehensive score of each country.

2.2 Spatial autocorrelation

Many sociological issues have a continuous process in geographical distribution and have spatial relevance, mainly manifested in the process of spatial diffusion and spatial interaction (Che.SL 2019). Spatial autocorrelation reflects a certain geographic phenomenon on a regional unit or the degree of correlation between a certain attribute value and a unified phenomenon attribute on a neighboring area unit. According to functions, it can be roughly divided into two categories: global spatial autocorrelation and localized spatial autocorrelation Spatial autocorrelation (Han.EJ 2018). The function of global spatial autocorrelation mainly lies in judging whether a certain phenomenon has agglomeration characteristics, describing the overall distribution of the phenomenon, but it cannot clearly indicate where it is concentrated. The local spatial autocorrelation can measure the specific scope of the agglomeration phenomenon.As shown in Figure 1, assuming a regular grid, each grid corresponds to an attribute value, with 0 representing that a certain thing

or phenomenon does not appear, and 1 representing it. "a" in Figure 1 is a strong autocorrelation, 0 and 1 are each clustered and distributed and each occupy half of the grid; "b" in Figure 1 is a strong negative correlation, and the data is evenly distributed; "c" in Figure 1 Random distribution is a specific distribution in a random pattern (it can be any of the random patterns).In the three sampling patterns in Figure 1 the spatial equivalence of any pattern at a certain time interval or time delay can be observed. The pattern is observed at an interval of one unit, and statistics are "1-1, 0-0, 1-0, 0-1", and then compare these values with the expected number of random patterns to determine whether there is spatial autocorrelation in this distribution pattern (Chun-Yu.Liu).This research follows the global-local approach.

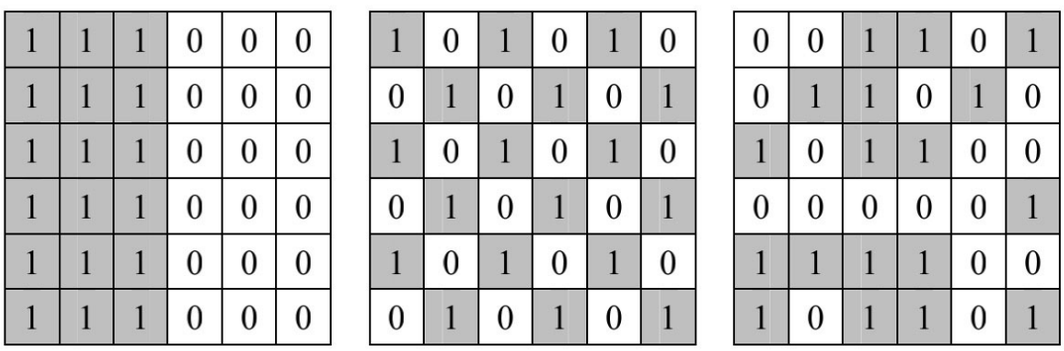


Figure 1. Spatial autocorrelation graph

The methods to describe the global spatial autocorrelation mainly include Moran'I and Geary's C. Because Moran'I is less likely to be affected by deviations from the normal distribution than Geary's C, Moran'I is more widely used (Cai.JX 2017) . Global Moran’I can discover the differences and correlations in the spatial distribution of observations (Long.KS 2017). Since the global spatial autocorrelation sometimes conceals the instability of the local state, when the global index cannot detect the spatial distribution pattern inside the region, the local index can effectively detect the spatial difference caused by the spatial autocorrelation. In actual research, the local Moran’I method decomposes the global Moran’I method into the local space, that is, for each distributed object in the space. Moran'I contains 4 aggregation states: high-high aggregation, high-low aggregation, low-high aggregation and low-low aggregation. The significance test is carried out by the LISA test chart, and the range is between [-1, 1]. And since the absolute value of the Z value conforms to the normal distribution, when the level is greater than 0.05, the null hypothesis is rejected, that is, the critical value of the 0.05 level of the normal distribution is 1.96 ($|Z|>1.96$, $p<0.05$). The specific calculation is completed by ArcGIS10.5 and Geoda2.0. The expression formula of agglomeration characteristics of independent variables in spatial autocorrelation analysis is as follows:

$$I = \frac{n\sum_{i=1}^{n}\sum_{j=1}^{n}W_{ij}(y_i-\overline{Y})(y_j-\overline{Y})}{(\sum_{i=1}^{n}\sum_{j=1}^{n}W_{ij})\sum_{i=1}^{n}(y_j-\overline{Y})^2}$$

"n" means the number of spatial regions, "yi" means the value of the independent variable in the "i" space region, "yj" means the value of the independent variable in the "j" space region, and "$\bar{Y}$" means the research space The average value of the regional independent variables, "Wij" is the spatial weight matrix, which

can be composed of distance method, area method, accessibility method and other methods. This study uses distance method for statistics, because the statistical object is the Asian Games participating countries, the distance method is similar Compared with the area method and the accessibility method, it is more suitable for the subject of this article.

Under the null hypothesis, Moran'I's expected value is as follows:

$$E(\mathrm{I}) = \frac{1}{n-1}$$

Assuming that the spatial objects are normally distributed, the variance of Moran'I is:

$$Var(\mathrm{I}) = \frac{1}{s_0^2(\mathrm{n}-1)(\mathrm{n}+1)}(\mathrm{n}^2\mathrm{s}_1 - \mathrm{ns}_2 + 3\mathrm{s}_0^2) - \mathrm{E(I)}^2$$

Assuming that the spatial objects are randomly distributed, the variance of Moran'I is:

$$Var(\mathrm{I}) = \frac{n((\mathrm{n}^2-3\mathrm{n}+3)\mathrm{s}_1 - \mathrm{ns}_2 + 3\mathrm{s}_0^2) - \mathrm{k}((\mathrm{n}^2-\mathrm{n})\mathrm{s}_1 - 2ns_2 + 6\mathrm{s}_0^2)}{s_0^2(\mathrm{n}-1)(\mathrm{n}-2)(\mathrm{n}-3)} - E(\mathrm{I})^2$$

Among them:

$$s_0 = \sum_{i=1}^{n}\sum_{j=1}^{n} W_{ij}s_1 = \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1,j\neq i}^{n}(W_{ij}+W_{ji})^2$$

$$s_2 = \sum_{i=1}^{n}(\sum_{j=1}^{n}W_{ij} + \sum_{j=1}^{n}W_{ji})$$

$$k = \frac{n\sum_{i=1}^{n}(\mathrm{y}_i - \overline{Y})^4}{(\sum_{i=1}^{n}(\mathrm{y}_i - \overline{Y})^2)^2}$$

Get Moran'I's Z-score score statistics:

$$z = \frac{I - E(\mathrm{I})}{\sqrt{\mathrm{var(I)}}}$$

3 Local spatial autocorrelation analysis of Asian Games medal differentiation

3.1 Global status of Asian Games medals

This research uses ArcGIS10.5 software to perform global spatial autocorrelation analysis, using "fixed distance band", Euclidean distance. The Moran'I index of the global spatial autocorrelation analysis of the comprehensive scores of the medals of the previous Asian Games is obtained. While performing the global spatial autocorrelation analysis, the analysis results were tested for significance. After passing the test, the analysis results were drawn with the year as the abscissa and the global Moran'I index as the ordinate (Figure 2).

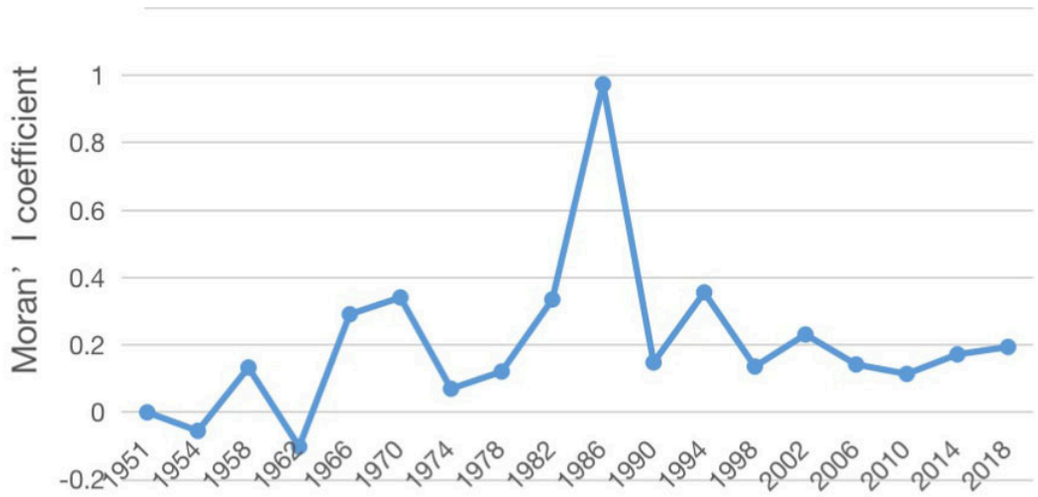


Figure 2. 1951-2018 Asian Games Olympic medal Moran index

From Figure 2, the distribution of medals in the 1951 Asian Games did not show a correlation. 1954 and 1962 showed a negative spatial correlation, and the rest showed a positive spatial correlation. The similarity between the participating countries (the Asian Games medal comprehensive score) Tends to agglomerate, but the degree of agglomeration is different in different years. In general, the spatial autocorrelation of the medals of the 18th Asian Games can be divided into four stages: The first paragraph is the exploration period (1951-1966), which changes from no correlation to weak negative correlation. , After turning to weak autocorrelation, it shows weak negative correlation. There are volatility changes in the two correlations. This may be due to the fact that the number of participating events, participating countries, athletes and medals set in the original Asian Games is small The resulting Moran index is low, the agglomeration effect is looming, and it does not show significant spatial autocorrelation. The second paragraph is the period of gradual formation (1966-1978). Although the spatial autocorrelation from 1970 to 1974 decreased and the curve fluctuated, the Moran index was all positive. It can be said that the overall development is good. It is the Asian Games medal distribution tends to The beginning of spatial autocorrelation. The third paragraph is the period of rapid development (1978-1986). This short three Asian Games has rapidly developed spatial autocorrelation from a low level to a top level. This is an important manifestation of the national strength of participating countries in the Asian Games, especially It was the Moran Index reached its peak in 1986, showing the balance of competition in the Asian Games and an important guarantee for the sustainable development of the Asian Games. It also reflects the importance of Asian countries to the Asian Games and the fighting spirit of athletes in various sports. Factors, the Asian Games medal distribution presents a higher spatial autocorrelation. The fourth stage is the stable development period (1986-2018). After the rapid development of spatial autocorrelation in 1986, it returned to a low level of development in 1990, and gradually reduced fluctuations, and generally turned to a stable development trend. This may be due to the rapid development of politics and economy in some Asian countries since 1990, which has led to the development of competitive sports, which has caused big differences between participating countries in the Asian Games and caused medals to be concentrated in some countries. Therefore, competition in the Asian Games is unbalanced, and only a few countries have won meager medals in a few events. This is the main reason for the low average Moran index in the fourth paragraph.

3.2 Regional situation of Asian Games medals

In order to further explore the status quo of the internal connection of the Asian Games medals, this study continued to use Geoda2.0 software to do a local spatial autocorrelation analysis of the 18th Asian Games medals, and also adopted the "fixed distance band", European distance. Generate Moran index scatter plots (Figure 3) and LISA cluster plots (Figure 4) to reveal the international spatial autocorrelation and spatial connection types of the Asian Games medal distribution.

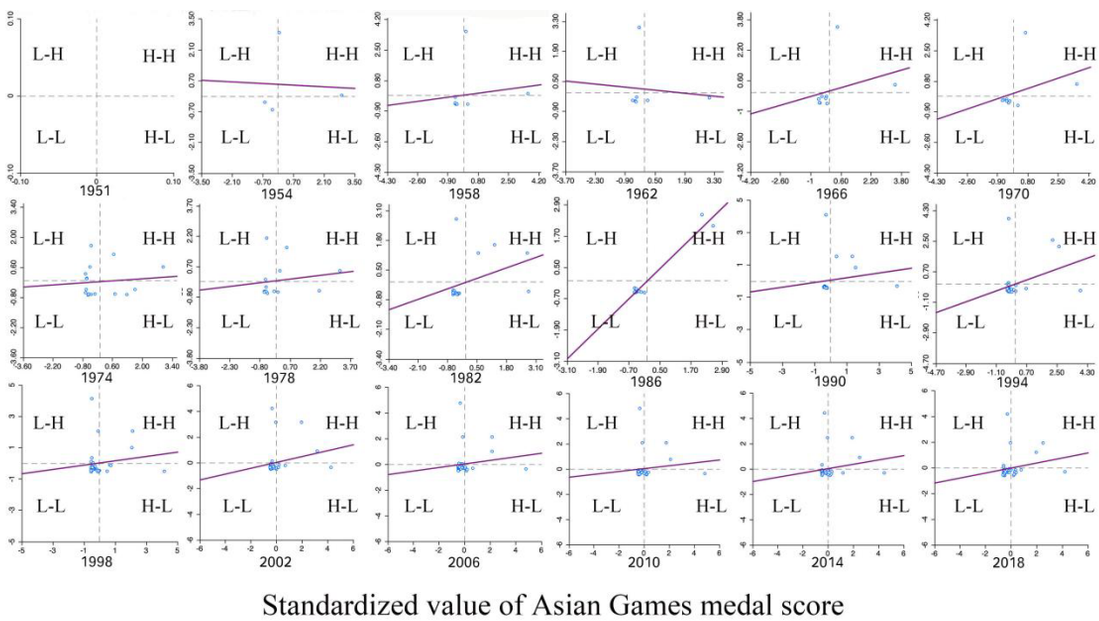


Figure 3. 1951-2018 Asian Games medal Moran index scatter chart

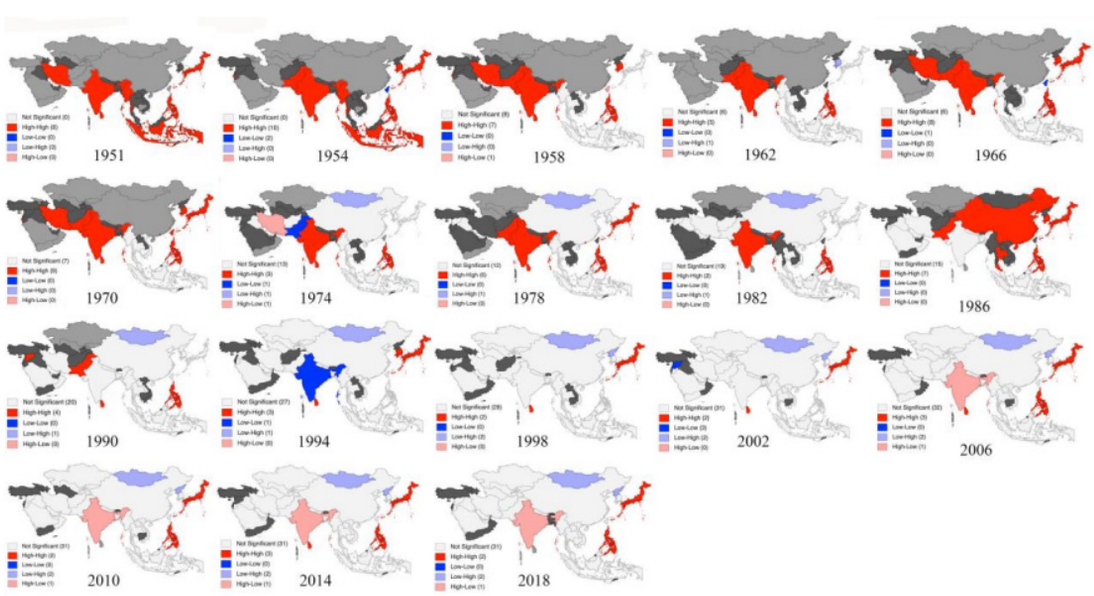


Figure 4. 1951-2018 Asian Games medal LISA gathering map

In the Moran index scatter diagram, the average value of the country distance weight matrix defined by the spatial weight matrix is used as the ordinate, and the standardized value of the comprehensive scores of

medals won by each participating country in the Asian Games is the abscissa. The four phenomena represent four different types of local spatial correlation between a country and its surrounding countries (Lera-Lopez 2018). The LISA cluster base map can display the data in the Moran index scatter chart in spatial form. "L" means "Low" and "H" means "High", then phenomenon 1 is "H-H", which means that countries with higher Asian Games medal scores gather in space; phenomenon 2 is "L-L", which means Asian Games Countries with low medal scores gather in space; Phenomenon 3 is "H-L", which means countries with high medal scores in the Asian Games are surrounded by countries with low medals; Phenomenon 4 is "L-H", which means countries with low medal scores in the Asian Games are surrounded by countries with high medals Surrounded by. Since the spatial autocorrelation of the Asian Games medal score has been divided into two sections in the global spatial autocorrelation analysis, when discussing the international spatial relationship, the local spatial autocorrelation analysis is carried out according to the above two sections to analyze its space The internal connection provides scientific and reasonable reference opinions for the future sports development of the participating countries of the Asian Games.

The first exploration period (1951-1966). In 1951, there is no marked point in the Moran index scatter plot (Figure 3). The Moran index of the global spatial autocorrelation analysis in Figure 2 is 0, while in the LISA cluster map (Figure 4), all participating countries are "H-H" Correlation, which means that when all geographic samples show the same phenomenon, the Moran index of the global spatial autocorrelation analysis will be 0, and the local spatial autocorrelation Moran index scatter plot does not show marked points. The negative values of 1954 and 1962 in Figure 2 mean that the slopes of the corresponding years of the Moran index scatter plot are also negative, which confirms that the global spatial autocorrelation and local spatial autocorrelation in this study are both significant statistical results. And "H-H" associations mainly appear in India and the Philippines. The second paragraph gradually took shape (1966-1978). The LISA agglomeration map shows that from 1966 to 1978, after 4 Asian Games, although a high agglomeration effect has not yet formed, it has never changed from agglomeration to agglomeration, and the "H-H" association continues to appear in India and the Philippines. The difference in the first stage is that the number of countries that have not shown a significant increase, the "H-H" association of some countries near India has shown instability, which means the continuous development of the Asian Games, the increase of participating countries, and the emergence of some sports powers. The originally maintained regional "H-H" association has been broken, indicating that there is a big difference in medal scores between participating countries in the Asian Games. The third period of rapid development (1978-1986). Judging from the slope of the Moran index scatter diagram, the local spatial autocorrelation of the three consecutive Asian Games showed a positive development trend, and developed to the most obvious slope in 1986. This makes the Indian region and the Philippines, which have been associated with the "H-H" in the two consecutive stages, changed hands, becoming a local spatial autocorrelation centered on China. Southeast Asia, West Asia and other regions are in a non-significant state, indicating that the Asian Games since 1978-1986 Medal scores are mainly concentrated in nearby countries with China as the core. The fourth period of stable development (1986-2018). According to the Moran index scatter chart, the spatial autocorrelation of medal scores in the Asian Games reached its peak in 1986 and gradually formed a trend of agglomeration. After that, although the slope of the Moran index declined, the trend of agglomeration still exists, which is consistent with stability. Definition of development. However, since 1990, the spatial autocorrelation dominated by the "H-H" association in the local area seems to have withdrawn from the stage, presenting the spatial autocorrelation in which the local area or country is not significant as the mainstream, along with some "L-H" associations and "H-L".

"Relevance, "L-L" relevance, this kind of spatial autocorrelation and agglomeration state is caused by the imbalance of the Asian Games medal score ratio among the participating countries, which means that a small number of countries score too high, and most countries score too low. The monopoly trend of competition medals has led to unbalanced competition.

4 Conclusion

This paper uses global spatial autocorrelation and local spatial autocorrelation to make statistics on the differentiation of Asian Games medals. The results show that the spatial autocorrelation of the 18th Asian Games held in 1951-2018 can be roughly divided into four stages, namely the first exploration period (1951-1966); the second stage gradually formed (1966-1978); The third period of rapid development (1978-1986); the fourth period of stable development (1986-2018). The spatial autocorrelation of the Asian Games developed from the negative spatial correlation and spatial autocorrelation volatility in the first paragraph, to the overall spatial autocorrelation in the second paragraph, and after the third paragraph developed to the peak, the fourth paragraph showed competitive events. The trend of medal monopoly has led to unbalanced competition. Competitive imbalance is the biggest threat to the hosting of competitive sports events. This will lead to the formation of sports culture in the dominant country, the creation of a sports training system, and the mastery of the winning rules. However, it has become a huge problem for the inferior country to defeat the dominant country to obtain medals. This is an important issue that the Asian Olympic Council and other related institutions need to resolve early.

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