



Study on the Spatial-temporal Characteristics of Camping Network Attention in China

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Camping has become one of the most important spaces in China for people to relax. However, there is currently limited research that analyzes China's camping from a spatiotemporal perspective. Based on the Baidu Index, this paper explores the spatial-temporal characteristics and influencing factors of the network attention of camping in China using statistical analysis and spatial analysis. The study found that: (1) 2011-2022, the inter-annual change characteristics of the camping network attention showed an overall upward trend, and there was explosive growth in 2022, mainly due to the impact of the COVID-19 pandemic. The annual variation of the attention of China's camping network shows that camping activities are primarily concentrated from March to October when the temperature comfort is higher. (2) The spatial characteristics pattern of the camping network attention was "more southeast, less northwest", but the overall distribution characteristics were balanced, and the degree of concentration was not high. (3) At the significance level of 0.05,

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the indicators, including GDP, tertiary industry, private passenger car ownership, per capita disposable income, total population at the end of the year, and the number of primary school students, were significant factors affecting the inter-annual change characteristics of the camping network attention. The gross regional product, tertiary industry, private passenger car ownership, per capita disposable income, and the total population at the end of the year, were important driving factors affecting the spatial distribution characteristics of the camping network attention. The follow-up research needs to consider more impact factors and refine the classification of impact factors to better provide a theoretical basis and guidance for the healthy and sustainable development of the domestic camping market and camping tourism.

Keywords: Camping; network attention; spatial-temporal characteristics; Baidu index; Geodetector.

1. INTRODUCTION

Originally camping was defined as staying in a tent in nature as a low-cost form of accommodation when on holiday recreation and tourism [1]. Over the past decade, camping has been referred to as glamping, an umbrella term for numerous types of accommodation provision [2]. At present, the phenomenon of recreational camping is viewed as particularly popular in the tourism economies of North America, Australia, and New Zealand [3].

The outbreak of the COVID-19 pandemic has led to a surge in demand for short trips and nearby tours, making camping increasingly popular as a preferred space for leisure and recreation in China [4]. In November 2022, the "Outdoor Sports Industry Development Plan (2022-2025)" was issued by eight departments, including the General Administration of Sport of China, the Development and Reform Commission, and the Ministry of Culture and Tourism. In the plan, "camping" was mentioned in 14 instances. Also in the same year, the Ministry of Culture and Tourism, the Central Civilization Office, the National Development and Reform Commission, and 13 other departments jointly released guidelines to promote the healthy and orderly development of camping tourism and leisure. These guidelines recognized and supported the stable development of commercial campgrounds, proposing the construction of campsites in various locations to develop recreational camping services. They encouraged the proliferation of camping to meet urban and suburban leisure needs. According to the "Research Report on China's Camping Industry and Benchmark Enterprise Analysis (2022-2023)," the core market size and the driven market size of China's camping economy have shown a rising trend year-on-year. In 2022, the core market size of China's camping economy reached 113.47 billion yuan, an

increase of 51.8% compared to the previous year, and it is expected that by 2025, the core market size will rise to 248.32 billion yuan, with the driven market size reaching 1440.28 billion yuan [5].

With the continuous expansion of the camping market, academic research on camping in China has also become more diverse. Currently, research on camping in China primarily focuses on insights gained from the development of camping abroad [6-7], planning and construction of campgrounds [8-9], suitability analysis of campgrounds [10-12], and the educational functions of campgrounds [13]. Recently, scholars have begun to explore the spatial distribution characteristics of campgrounds from a geographical perspective. For example, Li Feng et al. used GIS techniques to analyze the overall distribution characteristics of national campgrounds and elaborated on the driving mechanisms of campground development [14]. Li Xinjian et al. constructed a dataset of Chinese camping locations, quantitatively analyzing the spatial distribution patterns, equilibrium trends, and spatial density of national campgrounds [4]. However, overall, there are relatively few research results in this area.

As of June 2021, the number of internet users in China reached 1.011 billion, with mobile internet users accounting for 1.007 billion [15]. Users search for related travel information through the internet, aggregating large volumes of information flows on search platforms like Baidu, forming big data on network attention (Baidu Index) [16]. Utilizing network attention to explore the temporal-spatial differentiation features and influencing factors of online attention on camping in China can not only provide theoretical guidance for the orderly development and construction of regional camping tourism projects but also offer theoretical support for the sustainable and healthy development of the camping industry.

2. MATERIALS AND METHODS

2.1 Data Sources

Baidu Index is an online keyword search program that records the online attention of internet users to keywords over a period [17]. All data on online attention to camping used in this paper come from official Baidu Index data. The time range of the data is from 2011 to 2022, covering 31 provincial administrative regions in China, excluding Hong Kong, Macao Special Administrative Regions, and Taiwan Province. National economic data and demographic data were obtained from the China Statistical Yearbooks published by the National Bureau of Statistics of China from 2012 to 2022.

2.2 Research Methodology

This study primarily uses Baidu Index data and statistical data analysis to investigate the spatiotemporal characteristics of China's camping network attention and their influencing

factors. The main technical process is illustrated in Fig. 1.

2.2.1 Inter-annual change index

The inter-annual change index represents the relative quantity of differences in online attention to camping over the years. The formula is as follows [18]:

$$Y = \frac{N_i}{(\sum_{i=1}^n N_i) / n} \quad (1)$$

Where Y is the inter-annual change index of online attention to camping, Ni is the annual numerical value of online attention to camping, n is the number of years, and the closer the value of Y is to 100%, the smaller the inter-annual change intensity of online attention to camping, indicating greater stability in attention. A very large or small Y value indicates greater inter-annual change intensity in online attention to camping, suggesting instability in attention.

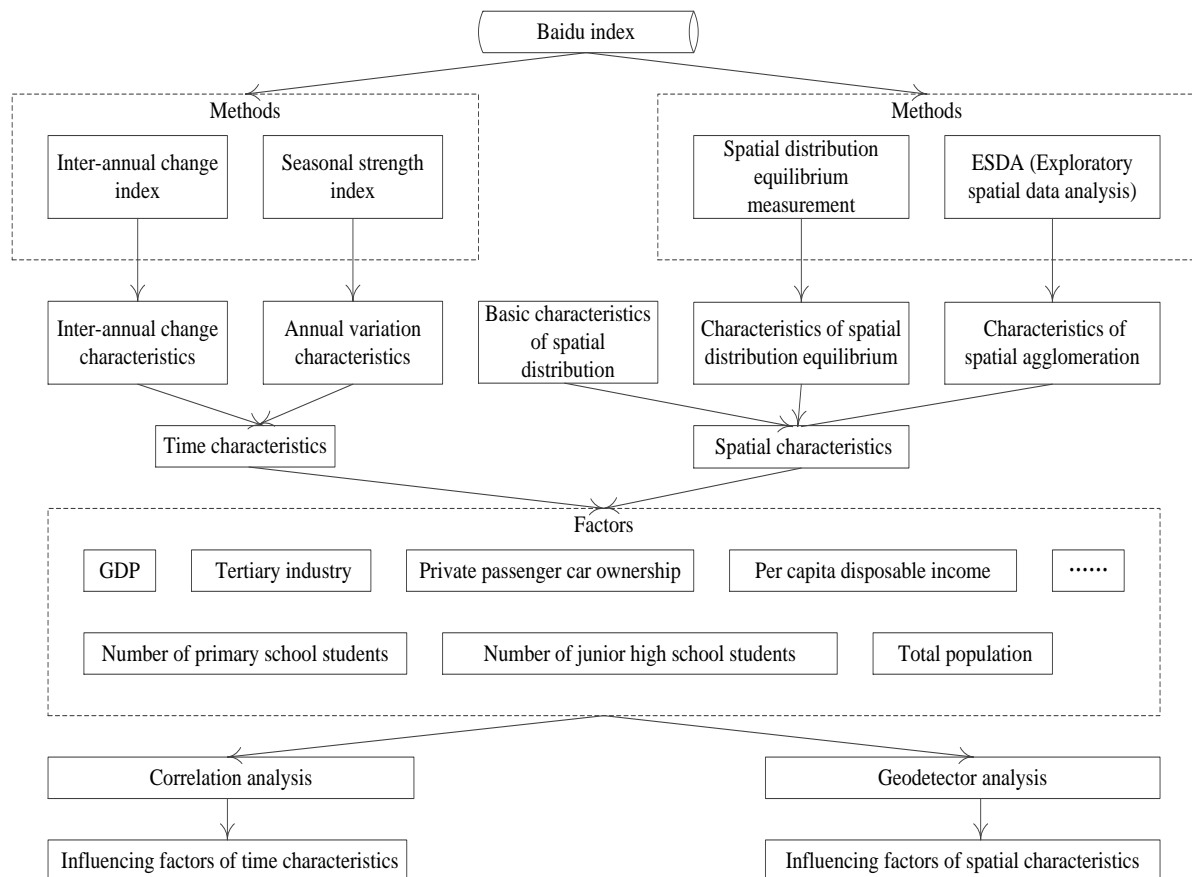


Fig. 1. Process flow diagram

2.2.2 Seasonal strength index

The seasonal strength index is used to analyze the concentration of the time distribution of online attention to camping, demonstrating the seasonal variation amplitude of online attention to camping and the difference between peak and off-season distributions. The formula is as follows [18]:

$$R = \sqrt{\left(\sum_{i=1}^{12} (x_i - 8.33)^2\right) / 12} \quad (2)$$

Where R is the seasonal strength index of online attention to camping, x_i is the percentage of the monthly online attention to camping index out of the total for the year. The larger the R value, the more pronounced the differences between seasons, indicating a large gap between peak and off-season periods of online attention to camping, and high concentration; if the R value approaches 0, it suggests that the gap between peak and off-season periods of online attention to camping is not significant, and the seasonal distribution is relatively uniform.

2.2.3 Spatial distribution equilibrium measurement

A geographical concentration degree is used to measure the spatial concentration of online attention to camping. The formula is as follows [18]:

$$G = 100 \times \sqrt{\sum_{i=1}^n (y_i / S)^2} \quad (3)$$

Where G is the geographical concentration degree index of national online attention to camping, ranging from 0 to 100, y_i is the online attention to camping value of the i -th province or city, and S is the total value of online attention to camping of all provinces and cities. The larger the G value, the higher the concentration degree of online attention to camping, and the more uneven the spatial distribution; the smaller the G value, the more dispersed the online attention to camping, and the more balanced the spatial distribution tends to be.

2.2.4 ESDA (Exploratory spatial data analysis)

Global Moran's Index is used to analyze the spatial association characteristics and spatial

differentiation characteristics of adjacent geographical elements [15]. The index ranges from [-1, +1]; if the index is greater than 0, positive correlation exists, and the closer to 1, the stronger the positive correlation; if the index is less than 0, negative correlation exists, and the closer to -1, the stronger the negative correlation; if the value is 0, it indicates that the spatial units are randomly distributed without any spatial aggregation phenomenon.

2.2.5 Geodetector analysis

Geodetector, as a measurement tool to explore spatial differentiation and elucidate underlying driving forces, has become an important means to discover the causes and mechanisms behind the formation of spatial patterns of geographical elements [19]. This paper uses geodetector analysis to identify factors influencing the spatial differentiation characteristics of national online attention to camping. The geodetector formula is as follows:

$$q = 1 - \frac{\sum_{h=1}^L N_h \sigma_h^2}{N \sigma^2} \quad (4)$$

Where q is the indicator of the spatial differentiation influencing factor detection power of online attention to camping, h is the stratification or division of online attention to camping Y or its influencing factor X; N_h and N are the numbers of units in stratum h and the study area, respectively; σ_h^2 and σ^2 are the variances of the Y values in stratum h and the entire area, respectively. The range of the q value is [0,1]; when q = 0, it indicates that online attention to camping is randomly distributed; the larger the q value, the greater the influence of the detection factor on the spatial distribution pattern of online attention to camping.

In this study, the annual average index of online attention to camping in each province and city across the country is selected as the dependent variable Y, and indicators such as regional gross product, tertiary industry, private passenger car ownership, per capita disposable income, year-end total population, and number of primary school students are selected as independent variables X. Using the natural breaks classification method in ArcGIS, the annual average index of online attention to camping in each province and city across the country, regional gross product, tertiary industry, private

passenger car ownership, per capita disposable income, year-end total population, and number of primary school students are divided into five categories.

3. RESULTS

3.1 Analysis of Temporal and Spatial Differentiation Features

3.1.1 Time characteristics

Inter-annual change: Obtaining daily numerical values of online attention to camping in each province and city to calculate the total changes in online attention to camping in China from 2011 to 2022 (Fig. 2). It can be seen that the national online attention to camping generally shows an upward trend. Among these, 2011-2020 belonged to the relatively slow growth stage, and 2021-2022 belonged to the stage of rapid explosive growth, especially in 2022, where the online attention to camping increased by approximately 108.3% compared to 2021 and increased by about 504.4% compared to 2011.

To further analyze the inter-annual change trends of national online attention to camping, the inter-annual change index of online attention to camping is calculated (Table 1). Results show that the inter-annual change index of national online attention to camping gradually approached 100% from 2011 to 2021, with attention tending toward stability, but in 2022, there was a significant fluctuation, with the inter-annual change index reaching as high as 243.9%. The reason for the significant change in 2022 should

mainly be attributed to the COVID-19 pandemic. As is well-known, during the COVID-19 pandemic, people's travel was restricted, making short trips and nearby tours more favored by tourists. Meanwhile, as one of the ideal spaces for leisure and recreation, camping has received considerable attention.

Annual variation characteristics: Taking the mean values of online attention to camping for each month from 2011 to 2022, trend charts of monthly online attention to camping are plotted (Fig. 3). As shown in Figure, the monthly online attention to camping exhibits a "double-peak" fluctuating change, albeit with one peak higher than the other. Among these, May has a higher peak, while October has a lower one. Generally speaking, online attention to camping is mainly concentrated from March to October. Starting from March, online attention to camping begins to rise, reaching its highest peak in May, after which it starts to decline. The curve is relatively smooth from June to October, and after October, the curve drops rapidly. The annual variation characteristics of online attention to camping reveal that the popularity of camping as a recreational activity is closely tied to seasonal factors. The "double-peak" phenomenon observed at the national level indicates that there are two distinct periods of heightened interest in camping, with the first peak coinciding with the spring season and the second peak occurring during the summer to early autumn. This may be influenced by factors such as school holidays, weather conditions, and traditional holiday periods.

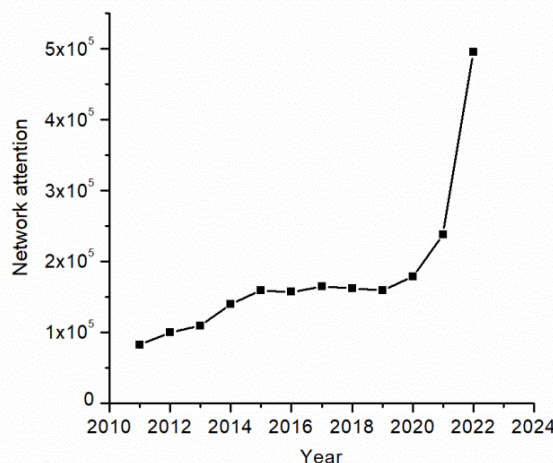


Fig. 2. Inter-annual change trend of the national camping network attention

Table 1. The inter-annual variation index of the camping network attention (%)

| Year | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|-------|------|------|------|------|------|------|------|------|------|------|-------|-------|
| Value | 40.4 | 49.1 | 53.6 | 68.5 | 78.1 | 77.2 | 81.0 | 79.8 | 78.1 | 87.8 | 117.1 | 243.9 |

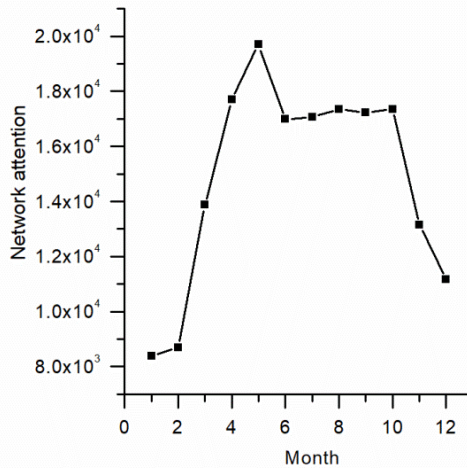


Fig. 3. Annual change trend of the national camping network attention

The seasonal intensity index is further used to measure the monthly attention index of the camping network, and the calculation results are shown that the R value of the country is 8.24669. The R value is relatively large on the whole, indicating that the seasonal variation of the camping network attention of the country is large, the distribution is biased to concentration, and the difference between off-peak and peak seasons is obvious.

3.2 Spatial Characteristics

3.2.1 Basic characteristics of spatial distribution

Based on the natural breakpoint method of ArcGIS software, the annual average camping network attention of all provinces and cities in China during 2011-2022 was divided into five levels (Fig. 4), and it was found that the overall pattern of annual camping network attention of all provinces and cities showed a spatial feature of "more in the southeast and less in the northwest". Among them, Jiangsu camping network attention is the highest, in the 5 level; Guangdong, Zhejiang, Beijing, Sichuan, and Shanghai have higher attention to camping network, which is in the 4 level; the 3 level includes 11 provinces and cities such as Shandong, Fujian, Hubei, Hunan et al; The 2 level includes Guizhou, Shaanxi, Jiangxi, Tianjin et al; Seven provinces and cities,

including Xinjiang, Xizang, Neimeng, and Qinghai, have the lowest camping network attention, ranking in the 1 level.

3.2.2 Characteristics of spatial distribution equilibrium

The geographical concentration index (G) is used to analyze the spatial distribution equilibrium of the attention of the national camping network during 2011-2022 (Table 2). It is found that the value of the G index ranges from 20 to 23, and the national average is 21.04, all of which are far less than 100, indicating that the distribution of attention of the national camping network is relatively balanced and the degree of concentration is not high. On the whole, the G index of national camping network attention showed a downward trend from 2011 to 2022, among which, from 2011 to 2013, there was a downward trend and then an upward trend, but from 2013 to 2022, the overall trend showed a fluctuating downward trend, but the decline was not large, and the maximum value appeared in 2013, G value was 22.15. The lowest value appeared in 2021, with a G value of 20.43, which decreased by 7.8%, indicating that from 2013 to 2022, the spatial distribution of attention in the national camping network was gradually enhanced and the degree of concentration gradually decreased.

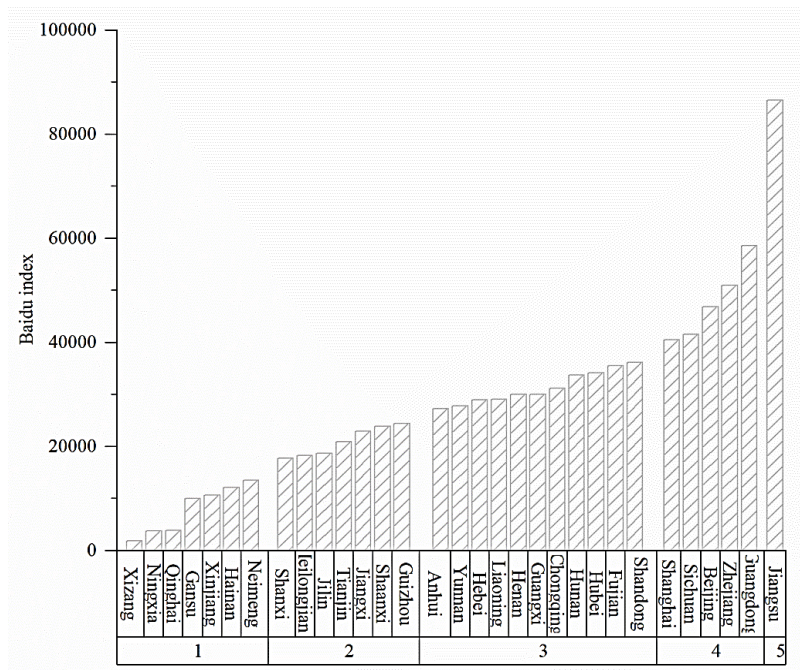


Fig. 4. Spatial distribution pattern of the national annual camping network attention

Table 2. Statistical table of geographical concentration coefficient of the national camping network attention

| Year | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Value | 21.82 | 21.40 | 22.15 | 21.88 | 21.59 | 21.59 | 21.30 | 20.91 | 20.95 | 20.63 | 20.43 | 20.64 |

3.2.3 Characteristics of spatial agglomeration

The global spatial autocorrelation index (Moran's I) of the national camping network attention was calculated based on the annual average camping network attention of all provinces and cities in China during 2011-2022. The value was 0.145>0, and the P value was 0.015<0.05, indicating that the national camping network attention showed a positive spatial correlation as a whole, but the degree of spatial agglomeration was low. The spatial dependence effect between geographical proximity is weak.

4. DISCUSSION

4.1 Analysis of Influencing Factors

4.1.1 Influencing factors of time characteristics

The annual distribution characteristics of camping network attention are mainly related to temperature. From the above analysis, it can be seen that the annual distribution of national camping network attention is mainly

concentrated in March to October, usually from November to February; the temperature is relatively low, not suitable for wild camping.

In order to analyze the factors affecting the inter-annual change characteristics of the national camping network attention, indicators such as GDP, tertiary industry, private passenger car ownership, per capita disposable income, total population at the end of the year, number of junior high school students and number of primary school students were selected, and Pearson correlation coefficient of SPSS tool was used for analysis (Table 3). The results showed that at the significance level of 0.05, GDP, tertiary industry, private passenger car ownership, per capita disposable income, total population at the end of the year, the number of primary school students, and other indicators showed a significant positive correlation with the attention of camping network, among which the first five indicators had the strongest correlation, and passed the significance level of 0.01. There was no significant correlation between the number of junior high school students and the attention of the camping network.

Table 3. Correlation analysis of factors influencing the annual distribution of the national camping network attention

| Index | GDP | Tertiary industry | Private passenger car ownership | Per capita disposable income | Total population | Number of junior high school students | Number of primary school students |
|-------|---------|-------------------|---------------------------------|------------------------------|------------------|---------------------------------------|-----------------------------------|
| Value | 0.912** | 0.905** | 0.908** | 0.918** | 0.887** | 0.089 | 0.707* |

Note : * $p < 0.05$, ** $p < 0.01$

Table 4. Factor detection analysis results

| Independent variable | GDP | Tertiary industry | Private passenger car ownership | Per capita disposable income | Total population | Number of primary school students |
|----------------------|-------|-------------------|---------------------------------|------------------------------|------------------|-----------------------------------|
| q statistic | 0.754 | 0.762 | 0.516 | 0.438 | 0.484 | 0.352 |
| p value | 0.000 | 0.000 | 0.009 | 0.039 | 0.037 | 0.258 |

Table 5. Interactive probe analysis results

| Interaction | GDP | Tertiary industry | Private passenger car ownership | Per capita disposable income | Total population | Number of primary school students |
|-----------------------------------|-------|-------------------|---------------------------------|------------------------------|------------------|-----------------------------------|
| GDP | 0.754 | | | | | |
| Tertiary industry | 0.772 | 0.762 | | | | |
| Private passenger car ownership | 0.822 | 0.832 | 0.516 | | | |
| Per capita disposable income | 0.833 | 0.833 | 0.823 | 0.438 | | |
| Total population | 0.832 | 0.842 | 0.586 | 0.886 | 0.485 | |
| Number of primary school students | 0.834 | 0.843 | 0.623 | 0.878 | 0.590 | 0.352 |

4.2 Influencing Factors of Spatial Characteristics

Indicators such as gross regional product, tertiary industry, private passenger car ownership, per capita disposable income, total population at the end of the year, and the number of primary school students were selected, and the factor detection method in geographical detector was adopted to explore the influencing factors on the spatial distribution characteristics of national camping network attention (Table 4). As can be seen from the table, except for the number of primary school students, the other five indicators all passed the significance test of 5%, indicating that these five indicators are important driving factors affecting the spatial distribution characteristics of the attention of the national camping network. The P-values of the three indicators, gross regional product, tertiary industry and private passenger car ownership, are all less than 0.01. It shows that these three indicators have a strong significance on the spatial distribution characteristics of China's camping network attention.

Through the statistics of q value, it can be seen that there is a positive explanatory power between regional GDP, tertiary industry, private passenger car ownership, per capita disposable income, total population at the end of the year and the spatial differentiation characteristics of the national camping network attention, and the explanation degree is as follows: GDP > Tertiary Industry > Private passenger car ownership > Total population at year-end > per capita disposable income. Among them, the q values of GDP, tertiary industry and private passenger vehicle ownership are greater than 0.5, indicating that these indicators have strong explanatory power. The q values of per capita disposable income and total population at the end of the year are less than 0.5, indicating that these two indicators have strong explanatory power.

The interaction of different factors on the spatial distribution characteristics of the national camping network was examined by using the interactive detection method in the geographic detector. There are 12 pairs of interaction results of the 6 factors (Table 5). It can be seen from the table that after the bivariate interaction, there is a phenomenon of double factor enhancement among the 6 independent variables, which indicates that the explanatory power of the factors has been significantly improved. It can be seen that the spatial distribution characteristics of

the attention of the national camping network are actually the comprehensive result of the interaction of many factors, among which the influence of any two independent variables after interaction is more explanatory than that of the single factor.

5. CONCLUSION AND PROSPECT

5.1 Conclusion

Based on the Baidu Index from 2011 to 2022, this paper explores the spatial-temporal differentiation characteristics and influencing factors of China's camping network attention by means of spatial analysis, and draws the following conclusions:

(1) The inter-annual characteristics of China's camping network attention show an overall upward trend, among which, the growth is relatively slow from 2011 to 2020, and explosive growth occurs from 2021 to 2022, mainly due to the impact of the COVID-19 pandemic epidemic; The annual variation of the attention of China's camping network shows that camping activities are mainly concentrated in March to October when the temperature comfort is higher.

(2) The attention of China's camping network shows the spatial characteristics of "more southeast, less northwest". Among them, Jiangsu camping network has the highest attention, and Xinjiang, Qinghai and the other 7 provinces and cities have the lowest attention. On the whole, the attention of China's camping network shows a positive spatial correlation, but the degree of spatial concentration is low.

(3) The main factors affecting the inter-annual change characteristics of camping network attention in China are GDP, tertiary industry, private passenger car ownership, per capita disposable income, total population at the end of the year, number of primary school students and other indicators, and their P-values are all less than 0.05, while the number of junior high school students in school has no significant correlation with camping network attention. The main factors affecting the spatial distribution characteristics of China's camping network attention are five indicators (gross regional product, tertiary industry, private passenger car ownership, per capita disposable income, total population at the end of the year) (P value is less than 0.05), among which the first three indicators have a more significant impact, and their p value is less than 0.01.

5.2 Prospect

(1) Develop peripheral products and services to promote the sustainable development of the camping market. The novel coronavirus outbreak has greatly promoted the rapid development of camping. During the epidemic period, people's travel is limited, and the demand for short and surrounding Tours has surged. Camping has attracted wide attention as a way to get close to nature and relax. After the epidemic, in order to continue the trend of camping, it is necessary to vigorously develop the surrounding camp-related products and services to promote the sustainable development of the camping market. Such as the launch of parent-child camping, theme camping and other more diversified camping products to meet the needs of different tourists; Holding camping festivals, camping conferences and other festival activities regularly to gather popularity and expand the exposure of camping tourism; Adding toilets, showers, charging points and other convenient facilities to improve the facilities and service level of the campsite.

(2) Strengthen publicity and promotion to improve the attention of the camping network in the northwest region. Xinjiang, Tibet, Inner Mongolia, Qinghai and other regions are very rich in camping resources, these places not only have unique natural scenery, vast grasslands, and magnificent snow mountains, but also mysterious national culture. However the camping network in these areas has relatively little attention. The follow-up needs to strengthen publicity and promotion, improve the attention of the camping network in these areas, and promote the development of the camping market in these areas. For example, through new media platforms such as Weibo, Wechat, Douyin, XiaoHongshu, etc., to increase the publicity of camping tourism and improve the visibility and influence of camping activities.

(3) Build camping outdoor education courses and products to broaden the development space of the camping market. From the perspective of influencing factors of camping network attention, there is a significant positive correlation between the number of primary school students and camping network attention. In the future, more students and parent-child guests can be brought into the camping market by designing campsite-related courses and products, building infrastructure and teaching equipment, and opening weekend theme camps, and cold and summer vacation theme camps.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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