

Research on the Correlation between Big Data-Driven Expansion of Urban Sports Spaces and Residents' Healthcare Concerns: The Case of Shaanxi Province

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Abstract: China's General Administration of Sport's "Key Points for Mass Sports Work in 2023" calls for local governments to increase public sports facilities and improve accessibility and standards. The expansion of sports spaces is inevitable. As society develops, residents' healthcare concerns evolve. Examining the correlation between sports space expansion and healthcare will inform government policy, fostering a win-win for mass sports and public healthcare. Against the backdrop of big data, this study first establishes four evaluation indicators to describe urban sports space expansion and two indicators to measure public healthcare concerns. Data for these ten indicators spanning 2014-2023 were collected, followed by outlier removal and missing value imputation. Second, this study employs multiple linear regression to examine the relationship between urban sports space expansion and residents' healthcare concerns. Results indicate a strong and largely positive correlation: as urban sports space expands, residents' healthcare concerns intensify.

Keywords: Multiple Linear Regression, Correlation Analysis, Healthcare Concern

1. Introduction

China's rapid economic development and advancing urbanization have led to increased work pressure and accelerated lifestyles among urban residents, resulting in annual declines in their physical health. Public sports service resources are scarce and unable to meet city dwellers' growing fitness demands[1]. To address this, the nation is promoting the Healthy China strategy and accelerating the construction of urban sports infrastructure. The term "health" is becoming increasingly significant to the public.

Numerous scholars have conducted in-depth research on residents' exercise habits, health status, and levels of health awareness. Zeng Yanlong argues that the growing demand for daily exercise is driving the gradual development of the sports industry. Internet big data integrates existing resources, thereby promoting the development of sports-related apps[2]. Guan Suye and Wu Xiaoping contend that the happiness of the entire population requires not only continuous progress in medical services but also proactive safeguarding of public health awareness[3]. Gola M noted the lack of space for physical activity in cities[4]. Sun Hannah quantified healthy lifestyles and health awareness[5]. Rhode Claire investigated whether health awareness measured in days, weeks, or months could alter health behaviors[6].

As a northwestern Chinese province and Silk Road origin, and a key hub of the Belt and Road Initiative, Shaanxi plays a vital role in the northwest region and nationally. This study uses urban sports facility and healthcare expenditure data from 2014 to 2023 as a sample to provide urban planning and public health policy insights. It identifies and recommends improvements to sports facilities, healthcare policies, and residents' access to sports and medical services and awareness. The findings may also be referenced by other provinces with similar contexts.

2. Data Collection and Indicator Establishment

This study investigates the correlation between the expansion of urban sports facilities driven by big data and residents' healthcare concerns. One key variable, urban sports facilities, is measured primarily by the number of basketball courts, fitness trails, gyms, and athletic tracks. By reviewing relevant

references[7-9], the study finds that another variable, residents' healthcare concerns, can be partially assessed through indicators such as the number of residents undergoing physical examinations and per capita annual expenditure on health checkups. Table 1 indicates Evaluation Indicator System for Digital Economy Development Level.

Table 1: Evaluation Indicator System for Digital Economy Development Level

Primary indicator	Secondary indicator	Variable
Sports Space X	Number of basketball courts	X_1
	Number of fitness trails	X_2
	Number of gyms	X_3
	Number of athletic fields	X_4
Residents' Healthcare Concerns Y	Number of residents undergoing physical examinations	Y_1
	Annual per capita expenditure on physical examinations	Y_2

When collecting sample data, to ensure sufficient data volume and authentic, reliable sources, the Shaanxi Provincial Sports Bureau and China's National Bureau of Statistics were selected as data platforms. To guarantee the scientific rigor and accuracy of this study, a ten-year data set spanning 2014 to 2023 was chosen as the research sample.

Following indicator definition, data collection, and preprocessing, the final sample data for urban sports spaces is presented in Table 2-3. Notably, the total number of sports venues in Shaanxi Province was collected independently and does not represent a simple summation of the four secondary indicators.

Table 2: Annual Urban Movement Space Data Summary for Shaanxi Province

	Total Number of Sports Facilities in Shaanxi Province	Number of Basketball Courts in Shaanxi Province	Number of Fitness Trails in Shaanxi Province	Number of Registered Gyms in Shaanxi Province	Number of Track and Field Facilities in Shaanxi Province
2014	46637	13886	863	1438	4839
2015	51730	13987	1101	1521	5121
2016	57637	14109	1230	1645	5419
2017	64502	14282	1670	1798	5735
2018	72507	14877	1780	1952	6070
2019	81505	15961	1983	2127	6424
2020	92519	17652	2298	2293	6798
2021	104341	20144	2590	2472	7194
2022	118841	23742	2782	2637	7613
2023	138935	28935	3897	3000	8070

Table 3: Annual Summary of Medical Concerns among Shaanxi Residents

	Annual Summary of Resident Physical Examinations at Healthcare Institutions in Shaanxi Province (Unit: 10,000 people)	Annual Per Capital Expenditure on Physical Examinations Among Residents in Shaanxi Province (Unit: CNY)
2014	783	525
2015	829	548
2016	889	572
2017	996	597
2018	1029	612
2019	1138	692
2020	1059	758
2021	1332	824
2022	1316	890
2023	1384	956

3. Using a multiple linear regression model to examine the relationship between the spatial expansion of urban sports facilities and residents' healthcare concerns

3.1 Model Overview

Multiple linear regression models are statistical frameworks used to examine the relationship between multiple independent variables and a single dependent variable. By constructing such models, researchers estimate the extent to which independent variables influence the dependent variable, thereby revealing

underlying relationships among variables. In the context of big data, multiple linear regression models can process extensive datasets and uncover hidden patterns and trends within the data. The expansion of urban physical activity space, as examined in this paper, represents a crucial aspect of urban development. It constitutes a significant component in the evolution of urban spatial structures and shifts in residents' lifestyles. Assuming a potential correlation exists between the expansion of urban physical activity space and residents' healthcare concerns, this study employs multiple linear regression to explore the relationship between these two factors. The ultimate aim is to investigate the potential impact of urban physical activity space expansion on residents' healthcare concerns.

The multiple linear regression model expression used in this paper is:

$$Y_j = \beta_0 + \beta_1 X_{1j} + \beta_2 X_{2j} + \beta_3 X_{3j} + \beta_4 X_{4j} + \mu \quad (j=1,2) \quad (1)$$

Among these, β_0 is the constant term, $\beta_1, \beta_2, \beta_3, \beta_4$ is the regression coefficient, and μ is the error term or residual.

3.2 Hypothesis Formulation

This study examines the correlation between the expansion of urban sports spaces and residents' healthcare concerns in Shaanxi Province. The expansion of urban sports spaces is measured using four secondary indicators: the number of basketball courts, the number of fitness trails, the number of registered gyms, and the number of athletic fields. Residents' healthcare concerns are assessed using two secondary indicators: the average annual expenditure per capital on physical examinations in Shaanxi Province.

H_1 : The expansion of urban sports spaces significantly impacts residents' healthcare concerns and exhibits a close linear correlation.

H_2 : The linear correlation between urban sports space and residents' healthcare concerns is substantive, not merely formal.

H_3 : The four secondary indicators describing urban sports space expansion exhibit a degree of mutual exclusivity. Specifically, the correlation among these four indicators does not exceed the correlation between these indicators and the two secondary indicators describing residents' healthcare concerns.

3.3 Hypothesis Test

3.3.1 Relationship between Urban Physical Activity Space Expansion and Annual Resident Health Examination Numbers at Medical Institutions

Using the data from the four secondary indicators describing urban sports space expansion in Table 2 as predictor variables, and the annual summary data on the number of residents undergoing physical examinations at medical institutions in Table 3 as the dependent variable, we performed multiple linear regression analysis using SPSS software. The results are presented in Tables 4–6.

Table 4: Multivariate Linear Regression Summary of Annual Aggregates for Urban Physical Space Expansion and Resident Physical Examination Numbers at Healthcare Institutions

R	R Square	Adjusted R-Square	Standard Error	Debin-Watson
.882	.658	.6631	13.291	2.278

Table 4 shows that the R-squared value is 0.658, indicating that the expansion of urban physical activity spaces can explain 65.8% of the annual aggregate variation in the number of residents undergoing physical examinations at healthcare institutions. The model demonstrates a high degree of fit. Considering other potential factors influencing the annual aggregate number of residents undergoing physical examinations at Shaanxi healthcare institutions and the inherent volatility of actual data, the error falls within an acceptable range.

Table 5: Coefficient Table for the Multiple Linear Regression Model of Annual Summary Data on Urban Physical Activity Space Expansion and Number of Residents Undergoing Medical Checkups at Healthcare Institutions

	Unstandardized Coefficient		Standardized Coefficient Beta	t	Significance	Linear Statistics	
	B	Standard Error				Tolerance	VIF
(Constant)	59.623	5.831		.240	.016		
Number of Basketball Courts in Shaanxi Province	-.031	.018	-.023	-.055	.033	.003	4.853
Number of Fitness Trails in Shaanxi Province	1.058	.224	.255	.258	.017	.001	3.863
Number of Registered Gyms in Shaanxi Province	-.195	.420	-.466	-.137	.002	.001	1.504
Number of Track and Field Facilities in Shaanxi Province	.352	.517	.770	.294	.023	.002	3.949

As shown in Table 5, the significance levels of all four secondary indicators describing the expansion of urban sports spaces are less than 0.05. This indicates that each of the four secondary indicators describing the independent variables significantly influences the annual aggregate number of residents undergoing physical examinations at healthcare institutions.

Substituting the coefficient results from Table 5 into Equation (1) yields the following expression for the multiple linear regression model:

$$Y_1 = 59.623 - 0.031X_{11} + 1.058X_{21} - 0.195X_{31} + 0.352X_{41} \quad (2)$$

In summary, the four secondary indicators of urban sports space expansion show a certain degree of correlation with the number of residents undergoing physical examinations at medical institutions, as shown in Table 6.

Table 6: Explanatory Table of Correlation between Urban Physical Activity Space Expansion Indicators and Number of Residents Undergoing Medical Checkups at Healthcare Institutions

Indicator	Conclusion	Explanation
Number of basketball courts in Shaanxi Province X_1	Significant negative correlation	As the number of basketball courts in Shaanxi Province increased, the annual total number of residents undergoing physical examinations at medical institutions in Shaanxi Province decreased.
Number of fitness trails in Shaanxi Province X_2	Significant positive correlation	As the number of fitness trails in Shaanxi Province increases, the annual total number of residents undergoing physical examinations at medical institutions in Shaanxi Province also rises.
Number of registered gyms in Shaanxi Province X_3	Significant negative correlation	As the number of registered fitness centers in Shaanxi Province increases, the annual total number of residents undergoing physical examinations at medical institutions in Shaanxi Province decreases.
Number of Track and Field Facilities in Shaanxi Province X_4	Significant positive correlation	As the number of athletic tracks in Shaanxi Province increases, the annual total number of residents undergoing physical examinations at medical institutions in Shaanxi Province also rises.

3.3.2 Relationship between Urban Physical Activity Space Expansion and Per Capital Annual Health Examination Expenditures of Residents

Using the data from the four secondary indicators describing urban physical activity space expansion in Table 2 as predictor variables and the per capital annual expenditure on physical examinations in Table 3 as the dependent variable, we conducted a multiple linear regression analysis using SPSS software. The results are presented in Tables 7–9

Table 7: Summary of the Multivariate Linear Regression Model for Urban Physical Activity Space Expansion and Per Capital Annual Health Examination Expenditure

R	R Square	Adjusted R-Square	Standard Error	Debin-Watson
.657	.728	.731	14.420004	1.897

As shown in Table 7, the R-squared value is 0.728, indicating that the expansion of urban sports space explains 72.8% of the annual per capital physical examination expenditure. The model demonstrates a high degree of fit. Considering other potential factors influencing the annual per capital physical examination expenditure in Shaanxi Province and the inherent variability in actual data, the error falls within an acceptable range.

Table 8: Coefficients Table for the Multiple Linear Regression Model of Urban Physical Space Expansion and Per Capital Annual Health Examination Expenditure

	Unstandardized Coefficient		Standardized Coefficient Beta	t	Significance	Linear Statistics	
	B	Standard Error				Tolerance	VIF
(Constant)	86.323	152.597		.487	.002		
Number of Basketball Courts in Shaanxi Province	.015	.004	.501	3.986	.010	.063	5.853
Number of Fitness Trails in Shaanxi Province	-.105	.048	-.653	2.194	.023	.011	8.863
Number of Registered Gyms in Shaanxi Province	1.365	.304	.230	1.200	.001	.001	3.504
Number of Track and Field Facilities in Shaanxi Province	-.011	.111	-.075	-.096	.015	.002	5.949

As shown in Table 8, the significance levels of all four secondary indicators describing urban sports space expansion are less than 0.05, indicating that these secondary indicators of the independent variables significantly influence per capital annual physical examination expenditures.

Substituting the coefficient results from Table 8 into Equation (1) yields the following expression for the multiple linear regression model:

$$Y_2 = 86.323 + 0.015X_{12} - 0.105X_{22} + 1.365X_{32} - 0.011X_{42} \quad (3)$$

In summary, the four secondary indicators of urban sports space expansion each exhibit a certain correlation with per capital annual physical examination expenditure among residents, as shown in Table 9.

Table 9: Explanatory Table of Correlation between Urban Sports Space Expansion and Per Capital Annual Health Examination Expenditure

Indicator	Conclusion	Explanation
Number of basketball courts in Shaanxi Province X_1	Significant positive correlation	As the number of basketball courts in Shaanxi Province increases, the annual per capital expenditure on physical examinations among Shaanxi residents also rises.
Number of fitness trails in Shaanxi Province X_2	Significant negative correlation	As the number of fitness trails in Shaanxi Province increases, the annual per capital expenditure on physical examinations among Shaanxi residents decreases.
Number of registered gyms in Shaanxi Province X_3	Significant positive correlation	As the number of registered gyms in Shaanxi Province increases, the annual per capital expenditure on physical examinations among Shaanxi residents also rises.
Number of Track and Field Facilities in Shaanxi Province X_4	Significant negative correlation	As the number of athletic fields in Shaanxi Province increases, the annual per capital expenditure on physical examinations among Shaanxi residents decreases.

4. Conclusion

From Tables 6 and 9, the correlation between urban physical activity spaces and residents' healthcare concerns can be derived, as shown in Table 10.

Table 10: Hypothesis Test Results and Interpretation Table Using the Multiple Linear Regression Model

Hypothesis	Test Result	Explanation
H_1	Accept	Urban recreational spaces significantly influence residents' healthcare concerns and exhibit a close linear correlation.
H_2	Accept	The linear correlation between urban physical activity spaces and residents' healthcare concerns is genuine, not merely formal.
H_3	Accept	The four secondary indicators describing the expansion of urban sports spaces exhibit a degree of mutual exclusivity. Specifically, the correlation among these four secondary indicators describing the expansion of urban sports spaces is no higher than the correlation between these four secondary indicators and the two secondary indicators describing residents' healthcare concerns.

As shown in Table 10, when urban recreational spaces expand, residents' healthcare concerns also increase accordingly. Therefore, it is recommended that the government accelerate the development of public fitness facilities to promote improvements in residents' physical health[10].

References

- [1] Zeng Wenyao. *Research on Strategies for Shaping Urban Public Sports Spaces in the Context of a Better Life* [J]. *Journal of Guangzhou Sport University*, 2018, 38(04): 12-14.
- [2] Zeng Yanlong. *Study on the Influence of Sports Apps on Urban Residents' Exercise Participation. Agency Acquisition* [J]. 2020, 1(10): 4-6.
- [3] Guan Suye; Wu Xiaoping. *Evolution and Reflection on Public Health Concerns Since the Founding of the People's Republic of China* [J]. *Journal of Wenzhou Medical University*, 2020, 1(7): 600-603.
- [4] Gola M;Buffoli M;Rebecchi A;Fior M;Daprà F;Vettori MP;Capolongo S.*Improving sport spaces into urban areas for healthy and inclusive communities: the case of Milan*MT.OUP[J]. 2021, 31(3):34-40.
- [5] Sun Hannah;Kalkbrenner Michael T;Bradley Michaela.*Development and Initial Validation of Scores on the Lifestyle Practices and Health Consciousness Inventory*[J].*Taylor&Francis*, 2024, 57(1) :1-14.
- [6] Rhode Claire.*The Effect of Health Awareness Days, Weeks, and Months: Can They Change Health Behavior?* [J].*Taylor&Francis*,2023, 27(4) :431-442.
- [7] Sun Yinan; Han Yujie. *Making Residents' Health More "Medically" Secure* [N]. *Heihe Daily*, 202405-08(3).
- [8] Zhang Qianqian; Jin Hua; Shi Xiaoxiao; Yu Dehua. *Current Status of Active Health Implementation in China and Recommendations for Implementation Strategies of Responsible Entities* [J]. *Chinese Journal of General Practice*, 2022, 25(31): 5-6.
- [9] He Wenjong; Yang Yixin. *Healthcare Governance and the Construction of a Healthy China* [J]. *Journal of Public Administration*, 2017, 14(02):24-27.
- [10] Xue Jian. *Creating Quality Sports Facilities Right at Residents' Doorsteps* [J]. *Sichuan Daily*, 2024-03-28(5).