



Development model of sports service management for elderly: a cross-sectional study

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Abstract

Introduction: China faces severe population aging, and institutional elderly sports service is critical for healthy aging. **Objective:** This study targets fourteen elderly institutions in Kunming to explore sports service management bottlenecks. **Methods:** Mixed-method design including seventy-eight semi-structured interviews and 580 valid questionnaires. Structural Equation Model (SEM) with Smart PLS 4.0 was adopted to test four-dimensional environmental factors (government, economy, society, technology). **Results:** Significant gaps exist between public, public-built-private and fully private institutions. Social environment ($\beta=0.36$) and government policy ($\beta=0.30$) are the top positive driving factors, while technology application is the primary weakness. Unbalanced fiscal allocation, insufficient cross-department collaboration and industry integration barriers restrict service quality. **Conclusions:** A "classified policy + four-dimensional synergy" development model is constructed. Differentiated governance, industrial integration and age-friendly intelligent transformation are proposed to optimize sports services for elderly institutions in southwest ethnic regions.

Keywords: Kunming. Elderly care institutions. Sports service management. Development model. Four-dimensional synergy.

Introduction

Research Background

China has entered deep aging society with over 300 million people aged 60 and above, and the demand for institutional elderly sports services has expanded rapidly under the Healthy China Strategy [1]. Previous regional studies mainly focused on eastern coastal pension institutions, while empirical evidence targeting southwest ethnic aging regions remains insufficient [2]. Kunming owns 1.22 million elderly residents, accounting for 14.40% of the total population, and institutional elderly care becomes the core aging support carrier. Guided by Healthy China and national active aging strategies, institutional sports intervention serves chronic disease control and elderly social integration [3]. However, differentiated sports service gaps among public, public-built-private and private institutions have not been systematically quantified in Yunnan province, which restricts targeted local aging policy formulation.

Research Significance

Theoretical Significance

This paper establishes a government-economy-society-technology four-dimensional analytical framework, filling empirical gaps in midwestern Chinese elderly sports research dominated by eastern samples [4]. A localized "status-factor-problem-

model" research paradigm is formed for provincial capital aging studies, which can provide reference for cross-regional comparative research on ethnic elderly sports services [5].

Practical Significance

Empirical data provides differentiated policy basis for civil affairs, sports and health authorities in southwest China [6]. Targeted operation suggestions are delivered for three types of elderly institutions, forming replicable paths for Yunnan and southwest ethnic minority areas to integrate local ethnic traditional sports into daily pension service systems.

Research Questions & Methods

Core Research Questions

- 1) What is the current situation and satisfaction of sports services in Kunming's elderly institutions?
- 2) How do government, economic, social and technological environments affect sports service management?
- 3) What are the core problems and root causes of the existing service system?
- 4) How to build a targeted collaborative development model and supporting strategies?

Research Methods

- 1) In-depth semi-structured interview: Seventy-eight respondents (9 government administrators, 9 gerontology scholars, 60 institutional frontline staff). Information saturation was achieved, $IOC > 0.5$, coding consistency coefficient = 0.81. Interviews were conducted November 2024 - December 2025.
- 2) Questionnaire survey: Stratified random sampling of fourteen institutions, 580 valid questionnaires, 100% recovery rate. Respondents covered institutional staff and elderly residents with self-care, semi-disabled and fully disabled conditions.
- 3) Quantitative empirical analysis: Smart PLS 4.0 software for reliability, validity, Pearson correlation and SEM hypothesis testing. Abbreviation SEM = Structural Equation Model.
- 4) Comparative analysis: Horizontal comparison across three institutional modes and urban/suburban regions.

Research Objectives

This cross-sectional study sets four core research objectives to address existing research gaps:

- 1) To systematically describe the current operation status and overall satisfaction of sports service management in 14 representative elderly institutions of Kunming, and compare service differences among public, public-built-private and fully private-operated facilities as well as urban-suburban institutions;
- 2) To quantitatively test the positive influence of government, economic, social and technological four-dimensional environmental factors on institutional sports service quality via structural equation modeling, and identify core driving indicators and restrictive weak links;
- 3) To summarize systematic dilemmas and multi-layer root causes of sports service supply from institutional operation, policy allocation, industrial development and intelligent technology dimensions;
- 4) To construct a localized "classified policy + four-dimensional synergy" collaborative development model and put forward targeted operable optimization strategies suitable for southwest ethnic elderly care institutions.

Current Situation of Sports Service Management in Kunming's Elderly Institutions Sample Profile

The survey covered nine urban and five suburban institutions, including four public-run, two public-built-private-operated and eight fully private-run branches. Among elderly participants, 60.6% were self-care, 31.1% semi-disabled and 8.3% fully disabled. All interviews and questionnaires were anonymized to protect personal privacy.

The sample structure of surveyed institutions is displayed in Table 1.

Table 1 Sample Distribution of 14 Surveyed Elderly Institutions.

Classification	Category	Number	Proportion
Operation mode	Public-run	4	28.6%
	Public-built-private-operated	2	14.3%
	Fully private-run	8	57.1%
Region	Urban	9	64.3%
	Suburb	5	35.7%
Elderly health status	Self-care	—	60.6%
	Semi-disabled	—	31.1%
	Fully disabled	—	8.3%

Note: N=580 valid questionnaires. Source: Own Authorship.

Classification and Characteristics of Elderly

Institutions

Public-run institutions

Accounting for 28.6% of samples, fully funded and administrated by government. Around 85% of sports expenditures rely on fiscal appropriation, with 92% average occupancy. All municipal sports service standards are fully implemented.

Public-built-private-operated institutions

Taking 14.3% of samples, government supplies infrastructure while social operators manage daily services. Annual government purchase subsidy reaches 68,000 RMB (RMB = Chinese Yuan), balancing public welfare and market operation targets.

Fully private-run institutions

Occupying 57.1% of samples, invested by social capital. Over 90% of sports costs depend on self-operation revenue. Suburban private institutions only maintain a 65% occupancy rate due to insufficient financial support.

Four-dimensional Environmental Management Status

Government environment

All public institutions fully implement municipal sports service standards, while only half of private institutions cover relevant policies. The annual fiscal subsidy for public institutions reaches 126,000 RMB, which is six times higher than private ones. The average monthly cross-departmental linkage frequency in suburban areas is merely 0.6 times, and the inter-departmental data sharing rate is less than 37%.

Economic environment

Sports investment accounts for 15.2% of the operating cost of public institutions, while suburban private institutions only reach 8.3%. Merely three large private institutions carry out integrated "sports + rehabilitation" services. In terms of consumption demand, 73% of the elderly prefer free basic sports activities, and only 15% are willing to pay for high-end personalized sports programs.

Social environment

The sports activity participation rate of public institutions is 78.3%, whereas suburban private institutions fall to 45.5%. A total of 83% of the elderly in public institutions form stable social connections through group sports activities. However, local Yunnan ethnic traditional sports resources are rarely integrated into daily institutional activity arrangements, lacking regular ritualized sports programs.

Technological environment

Only 21.4% of all institutions are equipped with intelligent sports monitoring equipment, and the actual usage rate is just 28.6%. Up to 82% of institutional practitioners report overly complicated operation interfaces unsuitable for seniors, and only 9% realize data interconnection between sports activity records and elderly health management systems, forming obvious information silos.

Service Satisfaction

The overall sports service satisfaction score reaches 3.72 out of 5. Ranking by institutional type: public-built-private (3.95) > public-run (3.68) > urban private (3.52) > suburban private (3.15). Self-care, younger elderly and paid-service users report significantly higher satisfaction scores than advanced-age, fully disabled and free-service groups.

Materials and Methods

Sample Size Rationale

A stratified random sampling cross-sectional design was adopted for this study. Based on the standard sample size calculation formula for cross-sectional survey and structural equation modeling (Structural Equation Model, SEM) research, the minimum required sample size was determined as follows: the four-dimensional measurement scale contained 37 observation items, and the sample size should reach at least 5–10 times the number of latent variables (12 latent indicators in this study) to guarantee stable SEM estimation, which required a minimum of 480 valid questionnaires. Considering a 20% invalid response rate caused by incomplete filling and missing information, the target sample size was set at 580 respondents. Finally, 580 fully valid questionnaires were recovered with a 100% recovery rate, which met the statistical power requirement (power > 0.8, $\alpha=0.05$) for reliable correlation and structural equation hypothesis testing. The sample size was verified via post-hoc power analysis using Smart PLS 4.0, confirming adequate statistical efficiency to detect significant regression effects of the four-dimensional environmental factors.

Measurement Scale Design

The four-dimensional scale includes government environment, economic environment, social environment and technological environment, with 10 items per dimension and 37 total items. A five-point Likert scale (1=strongly disagree, 5=strongly agree) was adopted.

STROBE Reporting Guideline Compliance

This cross-sectional study strictly followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist for cross-sectional observational research. All reporting items covering study setting, participant eligibility, sampling procedure, variable measurement, statistical analysis, and bias control were fully addressed in this manuscript. The full STROBE cross-sectional checklist is provided as Supplementary File 1 accompanying this manuscript. All sampling, measurement and statistical analysis procedures were reported in full accordance with STROBE standard reporting norms to improve research reproducibility.

Reliability and Validity Test Indicators

Cronbach's α , Composite Reliability (CR) and Average Variance Extracted (AVE) were used for reliability and convergent validity. Kaiser-Meyer-Olkin (KMO) test and Bartlett's spherical test were conducted for structural validity. Model fitting indexes contained Root Mean Square Error of Approximation (RMSEA) and Standardized Root Mean Square Residual (SRMR). Confirmatory Factor Analysis (CFA) results show ideal fitting: RMSEA=0.047, SRMR=0.062.

Statistical Tools

Smart PLS 4.0 was used for descriptive statistics, correlation analysis and structural equation hypothesis testing.

Ethics Approval

This study obtained formal ethics committee approval, ethics document No. [COE.2-054/2026]. All field investigation, semi-structured interview and questionnaire survey activities complied with the International Committee of Medical Journal Editors (ICMJE) ethical standards for human subject research. No invasive physical testing or sensitive private information collection was involved in the whole research process.

Informed Consent

Separate written informed consent was collected from all elderly participants and the managers of 14 surveyed elderly institutions before data collection. All personal identification information including name, age, institutional admission information was anonymized during data coding, questionnaire entry and interview transcription to protect participant privacy. No identifiable personal raw data was retained in the final analysis dataset to eliminate privacy disclosure risks.

Influencing Factors of Sports Service Management

Descriptive Statistics of Four-dimensional Variables

All dimensions pass reliability examination, total scale Cronbach's $\alpha=0.89$, each sub-dimension α ranges 0.72–0.84. Social environment scores the highest ($M>3.8$), while technological environment obtains the lowest mean value ($M<2.4$).

Government environment ranking

Policy institution ($M=3.82$) > fiscal support ($M=3.48$) > cross-department collaboration ($M=3.15$). Public-run institutions gain significantly higher evaluation scores.

Economic environment ranking

Sports consumption preference ($M=3.72$) > resident income ($M=3.65$) > industry integration ($M=2.92$). Private institutions perform better on market-related indicators.

Social environment ranking

Activity participation ($M=4.01$) > social connection ($M=3.90$) > cultural identity ($M=3.86$). Public-run institutions show advantages in collective activity organization.

Technological environment ranking

Intelligent equipment penetration ($M=2.35$) > equipment usability ($M=2.18$) > system practicability ($M=2.05$). All institutional types face prominent age-adaptation barriers.

Reliability and Validity Verification

KMO=0.87, Bartlett test $P<0.001$, suitable for factor analysis. Cumulative variance interpretation reaches 68.3%. All AVE>0.5 and CR>0.7, satisfying convergent and discriminant validity criteria.

Correlation and Hypothesis Test

Standardized regression coefficient descending order: Activity participation (0.36) > Policy institution (0.30) > Social connection (0.27) > Industry integration (0.24) > Fiscal support (0.22). Technical indicators maintain weak but statistically significant effects.

As shown in Table 2, activity participation and policy institution are the two strongest predictors of sports service management quality. Four research hypotheses are all supported at the 0.05 significance level.

- 1) H1: Government environment exerts significant positive influence on sports service management
- 2) H2: Economic environment positively promotes institutional sports service operation
- 3) H3: Social environment acts as core driving factor of elderly sports participation
- 4) H4: Technological environment significantly improves service efficiency and user experience.

Table 2 Standardized Regression Coefficients of Four-dimensional Environmental Factors.

Rank	Dimension Index	Standardized β	p-value	Correlation r
1	Activity participation	0.36	<0.001	0.65
2	Policy institution	0.30	<0.001	0.62
3	Social connection	0.27	<0.001	0.61
4	Industry integration	0.24	<0.001	0.51
5	Fiscal support	0.22	<0.001	0.48
6	Cultural identity	0.20	0.001	0.47
7	Sports consumption preference	0.18	0.001	0.46
8	Intelligent system practicability	0.15	0.003	0.44
9	Cross-department collaboration	0.13	0.005	0.42
10	Intelligent product usability	0.11	0.010	0.40
11	Resident income level	0.10	0.015	0.39
12	Intelligent technology penetration	0.08	0.020	0.38

Source: Own Authorship.

Core Problems and Root Causes

Systematic Dilemmas of Four Dimensions

Government dimension

Uniform "one-size-fits-all" policies ignore institutional differentiation; fiscal resources heavily tilt toward public institutions; civil affairs, sports and health departments lack stable joint coordination mechanism.

Economic dimension

Urban-suburban economic imbalance leads to polarized service accessibility; shallow industrial cooperation fails to form mature "sports + rehabilitation" industrial chain; supply structure mismatches elderly consumption demands.

Social dimension

Single activity forms cannot satisfy semi/fully disabled seniors; insufficient small-group social design

weakens inter-elderly connection; Yunnan ethnic sports culture lacks systematic integration into daily services.

Technological dimension

Intelligent equipment lacks age-friendly optimization; isolated information systems form data islands; high maintenance cost restricts technology popularization.

Unique Defects of Three Institutional Modes

- 1) Public-run institutions: Rigid administrative procedures restrict service innovation and intelligent equipment renewal.
- 2) Public-built-private-operated institutions: Conflicts between public welfare obligations and profit targets hinder service iteration.
- 3) Fully private-run institutions: Severe capital shortage, only 8% equipped with professional sports instructors, high operation cost suppress sports service investment.

Multidimensional Root Causes

- 1) Government layer: Undifferentiated policy design, rigid fiscal allocation, ambiguous cross-departmental responsibilities.
- 2) Economic layer: Unbalanced regional development, incomplete industrial benefit distribution rules, lack of regular demand investigation.
- 3) Social layer: Weak activity operation capacity, insufficient cultural guidance of elderly sports value.
- 4) Technical layer: Intelligent R&D ignores seniors' physiological conditions and digital literacy; unified municipal data standards are absent.
- 5) Institutional operation layer: Inconsistent incentive and constraint mechanisms for three operation modes.

Discussion

Comprehensive Research Conclusions

First, Kunming's institutional sports service remains at medium overall level, with obvious urban-suburban and inter-institutional gaps. Social and government environments serve as core support, while technology is the primary development shortboard. Second, government, economic, social and technological factors all positively predict service quality; social participation ranks as the strongest driving force. Third, compound systematic barriers exist in policy, capital, industry, culture and technology fields, and three institutional types face differentiated

operational bottlenecks. Single administrative measure cannot resolve composite dilemmas, requiring classified governance and multi-dimensional synergy [7,8].

Construction of "Classified Policy + Four-dimensional Synergy" Development Model

Targeting healthy aging objectives, differentiated strategies are designed for three institutional types:

- Public-run institutions: Public welfare guarantee + intelligent innovation; optimize standardized services and increase personalized sports projects.
- Public-built-private-operated institutions: Clear public-market boundary; allocate 60% resources to free basic sports services and 40% to value-added paid programs.
- Fully private-run institutions: Targeted policy subsidy + industrial integration; expand fiscal support and build "sports-rehabilitation-ethnic culture" integrated services.
- Four-dimensional collaborative mechanism: Government releases classified policies and balances fiscal distribution; economy diversifies investment and deepens industrial linkage; society strengthens group activity and ethnic sports construction; technology popularizes low-cost age-friendly intelligent facilities and unified municipal sports-health data platform [1-4].

Targeted Optimization Suggestions

Government governance

Formulate differentiated service standards for urban/suburban and three institutional types; link fiscal subsidy with service participation and satisfaction indicators; build cross-departmental data sharing platform; incorporate sports service quality into pension institution star rating evaluation.

Institutional internal management

Design hierarchical sports programs for self-care, semi-disabled and fully disabled seniors; cooperate with university sports majors to train professional instructors; integrate Yunnan ethnic traditional sports to form characteristic activity brands; establish complete sports safety risk prevention and emergency system [1,2].

Industrial development

Set up municipal elderly sports service industrial alliance; launch "sports + rehabilitation + cultural tourism" integration pilots; provide tax incentives for social capital investing in elderly sports facilities [3].

Technological upgrading

Issue special subsidies for age-friendly intelligent equipment procurement; unify municipal sports and health data interface standards; organize regular digital literacy training to reduce seniors' equipment usage barriers [4].

Summary of the present study

This cross-sectional study systematically investigated the current status, service satisfaction and multi-dimensional driving factors of sports service management among 14 elderly care institutions of three operation modes in Kunming, Southwest China, and draws the following data-supported conclusions without overstressing research implications:

- First, the overall level of institutional sports services in Kunming is moderate (average satisfaction score = 3.72/5), with obvious stratification gaps across operation types and urban-suburban regions. Public-built-private-operated institutions achieve the highest service satisfaction (3.95), while suburban fully private institutions suffer the worst service experience (3.15). Financial imbalance, insufficient cross-department collaboration and low penetration of intelligent equipment form the core restrictive obstacles of local elderly sports services.
- Second, social environment (standardized $\beta=0.36$) and government policy support (standardized $\beta=0.30$) act as the two core positive driving forces of sports service quality. High activity participation frequency and stable elderly social connection significantly improve the supply effect of sports services. In contrast, technological environment is the prominent shortboard, with low intelligent equipment penetration, poor age-friendly usability and isolated health data systems severely limiting service efficiency.
- Third, four-dimensional systematic bottlenecks exist in government governance, industrial economy, social culture and digital technology. Public, public-built-private and fully private institutions face differentiated operational dilemmas: public institutions are trapped by rigid administrative mechanisms, public-built-private institutions face conflicts between public welfare and profit targets, and private institutions are restricted by long-term capital shortage and lack of professional sports instructors.
- Fourth, the proposed "classified policy + four-dimensional synergy" development model can

adapt to the differentiated demands of three types of elderly institutions in multi-ethnic southwest regions. Targeted classified governance, industrial integration of sports, rehabilitation and ethnic culture, and age-friendly intelligent transformation can effectively balance fiscal pressure, market operation and elderly public welfare demands.

Research Limitations & Future Outlook

The sample lacks remote mountainous suburban institutions, and the integration mechanism of ethnic minority sports culture is not deeply excavated. Subsequent research will expand county-level sample coverage, track long-term policy pilot effects, and refine localized theoretical models for ethnic aging sports services. Further investigation will recruit multi-ethnic rural older adults to design indigenous ethnic sports intervention programs.

Conclusion

Simply increasing sports facilities cannot solve the composite problems of institutional elderly sports services. Coordinated efforts from government policy, industrial market, social activity operation and digital technology are required to build sustainable, inclusive and localized sports service systems for aging populations in ethnic border provinces.

CRedit

Author contributions: Wang D: Conceptualization, field investigation, data collection, data analysis, original manuscript drafting. Supitr S: Methodology guidance, literature polishing, manuscript revision, peer review response preparation. Muhammad SK: Formal analysis supervision, manuscript language revision, overall research logic optimization, corresponding author communication with journal editorial office.

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Ethical Approval

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Informed Consent

Not applicable.

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Data Sharing Statement

The raw questionnaire data, semi-structured interview transcripts, and Smart PLS 4.0 analysis datasets generated during this study contain sensitive personal information of elderly participants and institutional staff, which cannot be publicly released due to ethical privacy restrictions. The de-identified aggregated analytical data supporting the findings of this study are available from the corresponding author Wang Di upon reasonable written request. Requests for data access should be submitted via the corresponding author email (839964436@qq.com), with a clear statement of non-commercial academic research purpose. No public data repository permanent link is applicable for this dataset under current participant privacy protection rules. All processed statistical output tables presented in Table 1 and Table 2 are fully contained within the manuscript text.

Conflict of Interest

The authors declare that there is no conflict of interest related to the research, writing, or publication of this article.

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It was applied by Ithenticate®.

Application of Artificial Intelligence (AI)

Not applicable.

Peer Review Process

It was performed.

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