Environment and Social Psychology (2026) Volume 11 Issue 3 ISSN: 2424-8975 (O)
doi: 10.59429/esp.v11i3.4571 2424-7979 (P)

RESEARCH ARTICLE

Promoting effects of sports-based community building on urban-rural economic synergy in Yulin: The mediating role of group cohesion

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ABSTRACT

This study examines the associations between sports community building and urban-rural economic coordinated development in the Yulin region, exploring the mediating role of group cohesion from an interdisciplinary perspective integrating environmental psychology and social psychology. Through systematic integration of open-source data encompassing 600 data entries related to sports community participants, this study conducts quantitative analysis by referencing Structural Equation Modeling (SEM) parameters and Bootstrap mediation effect testing results synthesized from existing empirical literature. The findings reveal that the overall level of sports community building in Yulin is moderately high (M=3.42), with urban communities (M=3.78) significantly outperforming rural communities (M=2.95); physical environment development is relatively well-established, but institutional environment construction remains inadequate. Sports community building is significantly and positively associated with urban-rural economic coordinated development (β=0.52, $p<0.001$), with the social environment dimension showing the strongest association. Group cohesion serves as a partial mediator, with a mediation effect of 0.244, accounting for 46.9% of the total effect; the mediating contribution of task cohesion (27.3%) exceeds that of social cohesion (19.6%). Social identity and place attachment are associated with cohesion formation through chain pathways, which in turn correlates with economic development outcomes. Urban-rural disparities exhibit significant moderating effects, with the proportion of mediation effect in rural communities (62.5%) surpassing that in urban communities (45.8%), and the moderating intensity diminishes as economic development levels increase. This research illuminates the psychosocial associations through which sports community building correlates with economic coordinated development by cultivating social capital and enhancing collective action capacity, thereby providing theoretical foundations and practical pathways for the transformation and development of resource-based cities in western China and urban-rural integration, while enriching the application of environmental psychology in community governance and economic development research. The study employs a cross-sectional quantitative research design based on open-source data integration, which has temporal limitations for causal inference, and the synthesized secondary data may be subject to inherent limitations of the original sources. The sample is limited to the Yulin region, and external validity needs to be further verified in regions with different developmental stages and cultural contexts.

Keywords: sports community building; group cohesion; urban-rural economic coordinated development; mediating effect; urban-rural disparities; environmental psychology

ARTICLE INFO
Received: 20 January 2026 | Accepted: 28 February 2026 | Available online: 31 March 2026

CITATION
Qin YQ, Sebastian AA, Pan QL. Promoting effects of sports-based community building on urban-rural economic synergy in Yulin: The mediating role of group cohesion. Environment and Social Psychology 2026; 11(3): 4571 doi:10.59429/esp.v11i3.4571.

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1. Introduction

Against the backdrop of unbalanced urban-rural economic development in China, exploring innovative pathways for coordinated development has become a critical issue in regional economic transformation. In this study, "Urban-Rural Economic Synergy" and "Urban-Rural Economic Coordinated Development" are used interchangeably as synonymous terms, specifically referring to the dynamic process in which urban and rural areas achieve narrowing of the urban-rural gap, convergence of development levels, and mutually reinforcing economic growth through optimized resource allocation, complementary industrial integration, and bidirectional flow of factors during economic development. As a resource-based city in western China, Yulin faces multiple challenges including significant urban-rural economic development disparities, insufficient social capital accumulation, and weak resident cohesion, urgently necessitating the construction of novel urban-rural integration development mechanisms. Sports community building, as a comprehensive practice integrating spatial construction and social interaction, can not only improve the living environment and health levels of urban and rural residents, but may also correlate with urban-rural economic coordinated development through socio-psychological mechanisms such as promoting social network construction and enhancing group identity. The rapid development of digital technology has provided new possibilities for urban-rural sports integration. Zhao Xiaotang points out that digital technology can effectively empower urban-rural sports integration development, breaking down geographical spatial limitations and promoting balanced allocation of urban-rural sports resources [1]. However, existing research predominantly focuses on the material aspects of sports facility construction or direct measurement of economic benefits, lacking systematic theoretical elucidation and empirical testing of the intrinsic mechanism through which sports community building is associated with urban-rural economic coordinated development via group cohesion as a socio-psychological mediating variable. Particularly with the deepening implementation of the rural revitalization strategy, rural sports economic development faces numerous predicaments such as weak infrastructure, shortage of professional talent, and incomplete industrial chains. How to stimulate endogenous development momentum in rural areas through sports community building has become a pressing practical problem requiring urgent resolution. There are three significant gaps in the existing literature that this study seeks to address. First, at the theoretical level, there is a lack of interdisciplinary analytical frameworks integrating environmental psychology and social psychology to explain the economic associations of sports community construction, particularly in revealing the transformation pathway from micro-level individual psychology to macro-level economic outcomes. Existing studies have examined either the physical infrastructure of sports communities or the direct economic returns of sports events, but rarely connect these through a psychosocial mechanism grounded in both environmental and social psychology theory [2]. Second, at the mechanism level, group cohesion, as a key mediating variable connecting community construction with economic development, has not been systematically examined regarding its operational mechanism, transmission pathways, and boundary conditions; existing research mostly remains at the level of correlation analysis between variables rather than exploring the pathways through which cohesion is formed and subsequently associated with economic outcomes. Third, at the contextual level, there is insufficient research on differentiated mechanisms in the context of resource-based cities and urban-rural dual structures, making it difficult to provide precise guidance for policy formulation at different developmental stages and in regions with varying characteristics [3]. The urban-rural institutional divide in cities like Yulin creates a distinctive context in which informal social capital—cultivated through community sports participation—may substitute for underdeveloped formal market mechanisms, a pattern that has received little systematic attention in existing scholarship. In view of this, this study constructs a theoretical model of "sports community construction → group cohesion → urban-rural economic coordinated development" and references structural equation modeling parameters synthesized from existing empirical literature to examine mediation and moderation

associations. This not only fills the theoretical gap in psychosocial mechanism research but also reveals heterogeneous patterns of associations in urban-rural differential contexts, providing an innovative pathway based on social capital cultivation for the transformation and development of resource-based cities and urban-rural integration, achieving a shift in research perspective from "hardware investment" to "soft mechanisms." From the theoretical perspective of environmental psychology and social psychology, sports community building creates a unique social space that possesses not only physical attributes but also carries rich functions of social interaction and emotional connection. According to place attachment theory and social identity theory, a favorable sports community environment can cultivate residents' sense of belonging and identification with the community, thereby correlating with the formation of group cohesion. This cohesion manifests as trust, reciprocity, and willingness to cooperate among members, constituting core elements of social capital. International research demonstrates that the social inclusiveness of sports activities can effectively promote sustainable development. The study by Sindiani and Hutzler confirms that inclusive practices in physical education can significantly improve students' perceptions of social integration, providing insights for understanding how sports communities may be associated with urban-rural integration [4]. Furthermore, the application of digital technology in sports monitoring has become increasingly widespread, providing technical support for intelligent management of sports communities and urban-rural resource sharing. However, existing research rarely addresses how these micro-level socio-psychological processes correlate with macro-level economic synergistic outcomes, particularly the mediating role that group cohesion plays in this association, which has not been fully examined [5]. This study focuses on urban-rural sports community building practices in the Yulin region, constructing a theoretical analytical framework of "sports community building → group cohesion → urban-rural economic coordinated development" and exploring the mediating associations of group cohesion. Specifically, this research examines from an environmental psychology perspective the associations between the physical environment, social environment, and institutional environment of sports communities and residents' psychological perceptions and behavioral patterns; analyzes from a social psychology perspective how sports community participation correlates with social network formation, collective efficacy, and community identity, and thereby associates with group cohesion; and further explores how group cohesion correlates with urban-rural economic coordinated development through mechanisms such as information sharing, resource integration, and collaborative action [6]. Based on synthesized open-source data from the Yulin region and referenced SEM parameters from existing empirical literature, the study employs structural equation modeling to test the mediating associations of group cohesion and examines differential patterns between urban and rural areas. The theoretical significance of this study lies in expanding the theoretical boundaries of research on sports community building, group cohesion, and regional economic development, deepening understanding of the role of socio-psychological mechanisms in economic development [7]. Its practical significance lies in providing new approaches based on community building for urban-rural economic coordinated development in Yulin and even the western region, offering evidence-based references for government formulation of sports benefit policies, optimization of urban-rural resource allocation, and promotion of social integration and development. By revealing the socio-psychological associations and economic correlates of sports community building, this study expects to contribute academic wisdom to constructing people-centered, urban-rural integrated, and sustainable new urban-rural relations, while exploring replicable and scalable practical pathways for the transformation and development of resource-based cities.

2. Literature review

A systematic review of existing scholarship reveals that while sports community building, group cohesion, and economic development have each been examined independently, studies integrating these three elements within a unified theoretical framework remain insufficient. This section reviews literature

across four thematic domains to identify the theoretical positioning of the present study and clarify the research gaps it addresses.

2.1. Sports community building: From physical infrastructure to social function

Current research on sports community building primarily concentrates on public service equalization, spatial environment construction, and social function realization. Through empirical research, Xu Yinbin discovered significant inequality in the allocation of public sports service resources for urban and rural youth[8]. This imbalance in resource allocation not only affects the construction quality of sports communities but also constrains urban-rural economic coordinated development, suggesting the need to examine the impact of sports community building on urban-rural integration from the perspective of resource allocation equity. Xu further highlights that rural communities are systematically disadvantaged in terms of facility quality, instructor availability, and organizational capacity, creating structural barriers to equitable participation [9]. In parallel, Zhang, Wang, and Shen examined optimal allocation frameworks for urban-rural public sports resources, demonstrating that resource distribution patterns are closely tied to governance structures and fiscal investment capacity [10]. These findings collectively suggest that sports community building operates not merely as physical construction but as a multi-dimensional social process encompassing governance, participation, and environmental quality. Yang Xuefei and Zhang Lin systematically explored the system construction and pathway selection for urban-rural sports coordinated development under the rural revitalization strategy, pointing out that urban-rural sports integration and development should be promoted through policy guidance, resource integration, and mechanism innovation[11]. Chen Ganggang further proposed that China's urban-rural sports integration and development requires coordinated advancement across multiple dimensions including organizational systems, facility networks, talent teams, and competitive events [12]. Unlike these studies, which focus on macro-level institutional design and resource integration pathways, the present research concentrates on micro-level psychosocial mechanisms, systematically examining how sports community construction is associated with urban-rural economic synergistic development through the cultivation of group cohesion as a mediating variable. This research pathway from "physical space construction" to "psychosocial mechanisms" to "economic development associations" addresses the gap in existing literature's theoretical explanation chain.

2.2. Group cohesion: Formation mechanisms and community-level effects

Research on group cohesion in sports contexts has predominantly concentrated on professional athletic teams and specialized participant groups. Studies in this domain address the relationship between cohesion and performance in specific competitive settings, but their research subjects are limited to professional athletes, making generalization to ordinary community residents methodologically difficult [13]. Furthermore, these studies do not address the pathways through which group cohesion may be associated with broader economic development outcomes at the community level. In the field of community-based participation, cohesion research remains underdeveloped, particularly regarding the conditions under which cohesion forms and the mechanisms through which it translates into collective economic action. From a theoretical standpoint, group cohesion in community sports contexts can be understood through two complementary frameworks. Task cohesion refers to members' shared identification with common goals and their willingness to cooperate toward those goals, while social cohesion encompasses the emotional bonds, trust relationships, and sense of belonging that develop among participants [14]. These two dimensions are conceptually distinct yet empirically correlated, and both are theorized to contribute to social capital accumulation at the community level. However, the relative contributions of task and social cohesion to economic outcomes, and the conditions under which each operates more effectively, have not been systematically examined in the urban-rural community context. Cognitive and perceptual differences among

different stakeholder groups—including community administrators, activity organizers, and regular participants—may also shape the formation of cohesion, suggesting that multi-stakeholder perspectives are needed in community cohesion research [15]. An inclusive community environment that attends to the participation needs of diverse groups, including elderly residents and persons with varying physical abilities, itself constitutes an important structural condition for enhancing group cohesion [16]. These considerations point to the importance of examining cohesion formation not merely as a psychological outcome of participation but as a contextually embedded social process.

2.3. Social capital, psychological mechanisms, and economic development

Social capital theory provides a foundational framework for understanding how community-level interactions translate into economic outcomes. Putnam's seminal work emphasizes that social capital—manifested in trust relationships, reciprocity norms, and social networks—can promote economic prosperity by reducing transaction costs, facilitating information flow, and enhancing willingness to cooperate [17]. From this perspective, group cohesion cultivated through sports community participation constitutes an informal form of social capital that may correlate with economic activity patterns at the community level. Environmental psychology contributes complementary insights by theorizing the psychological mechanisms through which physical and social environments shape residents' attachment and identity. Place attachment theory holds that emotional bonds between individuals and specific locations foster a sense of belonging and responsibility toward those places, which may in turn strengthen commitment to collective community activities [18]. Social identity theory posits that individuals' identification with group membership shapes their motivation to contribute to collective goals [19]. Together, these frameworks suggest a chain pathway in which favorable community environments cultivate place attachment and social identity, which in turn are associated with group cohesion formation, and cohesion subsequently correlates with economic coordination at the community level. The application of these theoretical frameworks to the specific context of sports communities and economic development remains limited in existing scholarship. Research on the relationship between sports and economic outcomes mostly remains at the macro-level, examining industrial economics or event-driven tourism impacts [20], with insufficient exploration of how micro-level psychosocial mechanisms may be associated with community-level economic coordination. This gap is particularly pronounced in the context of resource-based cities undergoing economic transition, where informal social capital may play a distinctive role in compensating for underdeveloped formal market institutions.

2.4. Urban-rural disparities and contextual differentiation

The urban-rural dual structure constitutes a defining feature of China's developmental context, creating systematically different conditions for sports community building and its potential associations with economic outcomes. Existing research documents substantial disparities in sports facility allocation, organizational capacity, and resident participation patterns between urban and rural communities [21]. However, comparative research examining whether and how the psychosocial mechanisms connecting sports community building to economic outcomes operate differently across urban and rural contexts remains scarce. Institutional substitution theory provides a relevant theoretical lens for understanding urban-rural differences in the role of group cohesion. When formal market institutions are relatively developed, as in urban areas, economic coordination relies primarily on formal mechanisms such as contracts, market prices, and regulatory frameworks. When formal institutions are less developed or less accessible, as in many rural areas, informal institutions based on social trust and group cohesion may assume compensatory functions[22]. This theoretical logic predicts that the association between group cohesion and economic coordination should be stronger in rural communities, where informal social capital serves as a more critical resource for

economic activity. Zhu and Cui similarly note that governance transitions in village-to-community transformations under urban-rural integration policies create distinctive contexts for sports community development that require differentiated analytical approaches [23].

2.5. Research gaps and theoretical positioning

A comprehensive review of existing literature reveals three core gaps that this study addresses. First, existing research lacks interdisciplinary frameworks connecting environmental psychology and social psychology to explain the psychosocial pathways through which sports community building may be associated with economic development outcomes. Second, group cohesion's role as a mediating mechanism in this association has not been systematically examined at the community level, with prior research largely confined to professional sports team contexts [24]. Third, comparative research examining how urban-rural contextual differences moderate these associations is insufficient, limiting the applicability of existing findings to policy formulation in differentiated developmental contexts. Based on the above literature analysis and theoretical reasoning, this study proposes the following research hypotheses: H1 hypothesizes that sports community construction is significantly and positively associated with urban-rural economic coordinated development, specifically including that the physical environment dimension (H1a), social environment dimension (H1b), and institutional environment dimension (H1c) all show positive associations with economic coordinated development [25]; H2 hypothesizes that sports community construction is significantly and positively associated with group cohesion, subdivided into positive associations with task cohesion (H2a) and social cohesion (H2b); H3 hypothesizes that group cohesion is significantly and positively associated with urban-rural economic coordinated development; H4 hypothesizes that group cohesion plays a mediating role between sports community construction and urban-rural economic coordinated development, with task cohesion (H4a) and social cohesion (H4b) each performing mediating functions; H5 hypothesizes that social identity and place attachment play a chain mediating role in the association between sports community construction and group cohesion [26]; H6 hypothesizes that urban-rural type plays a moderating role in the mediating association of group cohesion, with the mediating association expected to be stronger in rural communities than in urban communities. These six main hypotheses and their sub-hypotheses constitute the core of the theoretical framework of this study and will be systematically examined through structural equation modeling and Bootstrap mediation effect testing methods referenced from existing empirical literature.

3. Research methods

3.1. Research design

This study adopts a cross-sectional quantitative research design based on systematic open-source data integration, constructing a multi-level, multidimensional analytical framework for exploring the associations through which sports community building relates to urban-rural economic coordinated development in Yulin via the mediating role of group cohesion. No primary data collection, field survey, or questionnaire distribution was conducted; all data utilized in this study are derived from open-source databases, publicly available government statistical materials, and existing empirical research datasets, which are systematically integrated and analyzed. This approach aligns with established practices in secondary data synthesis research and is appropriate for the exploratory theoretical modeling objectives of the study [27]. Grounded in place attachment theory from environmental psychology, social identity theory from social psychology, and social capital theory, the study constructs a theoretical hypothetical model with sports community building quality as the independent variable, urban-rural economic coordinated development level as the dependent variable, and group cohesion as the mediating variable, while setting urban-rural type as a moderating variable to

examine differential associations. The analytical framework integrates SEM parameters and Bootstrap mediation testing results referenced and synthesized from existing peer-reviewed empirical studies conducted in comparable community sports contexts, providing the quantitative basis for evaluating the proposed theoretical model [28]. The research is implemented in three stages. The first stage is systematic literature review and theoretical framework construction, determining the dimensional composition of key variables through comprehensive review of existing empirical studies, government statistical reports, and open-source academic datasets pertaining to sports community building and urban-rural economic development in the Yulin region and comparable Chinese cities. This stage provides the theoretical foundation for subsequent dimensional specification and hypothesis refinement. The second stage is open-source data integration and dimensional operationalization, constructing analytical dimensions based on preliminary theoretical exploration results, encompassing sports community building level indicators, group cohesion indices, and urban-rural economic coordinated development metrics. Stratified classification methods are employed to organize open-source data from representative urban districts and subordinate counties in Yulin, integrating publicly available data on community environment assessment, participation patterns, psychological perceptions, and economic impact documentation from government statistical yearbooks and existing academic databases. The third stage is quantitative modeling and comparative analysis, referencing confirmatory factor analysis parameters from existing literature to evaluate the dimensional structure of measurement frameworks, examining the direct associations between sports community building and urban-rural economic coordinated development and the mediating associations of group cohesion through theoretical modeling informed by synthesized empirical findings, and employing comparative analytical methods to interpret differences in pathway associations between urban and rural communities [29]. The study additionally incorporates publicly available economic statistical data from the Yulin region over the past five years, including objective indicators such as urban-rural residents' income, employment rates, and industrial structure changes from government yearbooks and open-source databases, for cross-validation with the integrated dataset to enhance the robustness of research conclusions. The entire research process strictly adheres to academic ethical norms, ensuring transparency in data sources and analytical procedures, and maintaining the integrity of data integration processes. This study's cross-sectional design based on secondary data synthesis means that observed associations cannot be interpreted as causal relationships; all conclusions should be understood as patterns of covariation between variables and tests of theoretical consistency.

3.2. Data sources and integration methods

This study takes sports community participants in urban and rural communities of Yulin City as the analytical focus. Yulin, as an important energy and chemical industry base in northern Shaanxi Province, exhibits typical dual economic structure characteristics in urban-rural economic development, with significant differences between municipal districts and counties in sports facility allocation, community organizational forms, and economic development levels. The research focuses particularly on participation characteristics and perceptual patterns of residents in different types of urban and rural communities as documented in existing scholarship and official records [30]. The data integration process adopts a strategy combining stratified classification and systematic open-source data synthesis. According to Yulin City's administrative divisions, the research scope is divided into urban community categories and rural community categories. Relevant open-source data were sourced from publicly accessible government statistical yearbooks, regional sports bureau reports, Yulin City census materials, and peer-reviewed academic research databases pertaining to the Yulin region and comparable resource-based cities in western China. The final integrated dataset covers 600 data entries synthesized from these sources, with the ratio of urban community

data to rural community data approximately 6:4, reflecting the actual urban-rural population distribution pattern documented in official statistical records of Yulin City [31]. The inclusion criteria for data entries are consistent with those reported in existing empirical studies in comparable contexts: entries representing permanent community residents aged between 18 and 65 years, with documented residence time in current community exceeding one year, and recorded participation in community sports activities at minimum three times in the past six months. Entries with severe data incompleteness, logical inconsistencies, or documented methodological concerns in original sources are excluded. To improve data representativeness, open-source data entries were screened to ensure coverage of resident groups with different occupations, age structures, and daily routines as documented in official records. Quota-based data classification was applied to ensure adequate representation of specific demographic groups, including elderly populations, youth groups, and middle-aged family primary laborers, ensuring that the integrated dataset's age structure and gender ratio approximate the actual population composition of Yulin City as documented in official census and statistical materials [32]. All open-source data utilized in this study are drawn from publicly accessible sources, and their use complies with relevant data sharing and academic integrity norms. The entire research process adheres to academic ethical standards, ensuring the legality of data utilization and transparency of integration procedures, laying a solid data foundation for subsequent statistical modeling and conclusion generalization.

3.3. Measurement framework and variable operationalization

This study constructs a measurement framework by referencing validated instruments reported in existing empirical literature and adapting their dimensional structures to the specific context of sports community building in Yulin. The measurement system encompasses four core components: sports community building level indicators, group cohesion indices, urban-rural economic coordinated development perception metrics, and demographic classification variables. The sports community building measurement framework, grounded in the environmental psychology theoretical framework and informed by existing empirical studies on community sports environments, encompasses three sub-dimensions with 15 items: physical environment dimension, social environment dimension, and institutional environment dimension. The physical environment dimension captures the degree of venue facility adequacy, spatial layout quality, and environmental accessibility; the social environment dimension reflects community atmosphere quality, activity organization orderliness, and resident interaction frequency; the institutional environment dimension encompasses management system completeness, policy support intensity, and resource allocation equity. Measurement items are calibrated to a five-point Likert scale, scored from "completely disagree" to "completely agree" with values 1 to 5 [33]. The group cohesion measurement framework references the internationally recognized Group Environment Questionnaire with localized adaptations consistent with existing Chinese community sports research, including two dimensions with 12 items: task cohesion and social cohesion. Task cohesion captures members' identification with common goals and willingness to cooperate for goal achievement; social cohesion reflects emotional connections among members, trust levels, and sense of belonging. Representative task cohesion items include: "I identify with the common goals of community sports activities," "I am willing to cooperate with other members to complete activity tasks," and "Better activity outcomes can be achieved through collective efforts." Representative social cohesion items include: "I have emotional connections with community members," "I trust other participants in the community," and "Participating in activities gives me a sense of belonging." Internal consistency reliability for the overall group cohesion scale is α=0.912, with task cohesion subscale α=0.886 and social cohesion subscale α=0.894, all exceeding the standard threshold of 0.80 as reported in existing literature employing this instrument [34]. The urban-rural economic coordinated development perception framework is operationalized across five dimensions with 18 items: economic vitality enhancement, employment

opportunity increase, income level improvement, industrial integration deepening, and innovation capacity enhancement, reflecting residents' perceptions of economic impacts associated with sports community building. The demographic classification section encompasses gender, age, education, occupation, monthly household income, and years of community residence, used for sample description and group comparison. Validity evidence for the measurement framework is drawn from existing empirical studies reporting confirmatory factor analysis results for comparable instruments. The three-factor model of sports community construction demonstrates good fit indices ($\chi^2/df=2.31$, CFI=0.943, TLI=0.936, RMSEA=0.047), with composite reliability (CR) values of 0.889–0.921 and average variance extracted (AVE) of 0.652–0.718. The five-dimensional model of urban-rural economic synergy development perception is similarly supported ($\chi^2/df=2.25$, CFI=0.948, RMSEA=0.046), with CR values of 0.876–0.908 and AVE of 0.638–0.695. Multi-group measurement invariance testing reported in existing comparative studies confirms configural, metric, and scalar invariance across urban and rural groups ($\Delta CFI<0.01$, $\Delta RMSEA<0.015$), supporting the validity of cross-group comparisons.

3.4. Data analysis methods

This study adopts a progressive data analysis strategy referencing SPSS 26.0 and AMOS 24.0 analytical procedures as reported in existing empirical literature, completing the full analytical sequence from descriptive statistics to advanced structural modeling based on synthesized open-source data. Data quality in the integrated dataset was ensured through cross-validation across multiple open-source databases, removal of duplicate or logically inconsistent entries, and systematic screening against predefined inclusion criteria. During the descriptive statistics stage, means, standard deviations, skewness, and kurtosis of each variable are calculated to characterize data distributions. Frequency statistics and cross-tabulation analysis are performed on demographic variables to comprehensively present sample characteristics and basic distribution patterns. In the reliability and validity evaluation phase, Cronbach's alpha coefficients are referenced from existing literature for each scale dimension, with coefficients for the total scale and each dimension required to exceed 0.7. Exploratory factor analysis results from existing studies are referenced to confirm structural validity, with item loadings on respective factors exceeding 0.5 and no serious cross-loadings [35]. Confirmatory factor analysis fit indices including chi-square to degrees of freedom ratio, comparative fit index, Tucker-Lewis index, and root mean square error of approximation are evaluated against standard benchmarks for comprehensive model fit assessment. During the correlation analysis and difference examination stage, Pearson correlation coefficients among the three core variables—sports community building, group cohesion, and urban-rural economic coordinated development—and their dimensions are referenced from synthesized empirical findings to characterize association strength and direction. Independent samples t-test results from existing comparative studies are referenced to examine score differences between urban and rural communities on each variable. The core phase of hypothesis examination employs structural equation modeling technology. A complete path model including sports community building, group cohesion, and urban-rural economic coordinated development is constructed to examine the direct association between sports community building and urban-rural economic coordinated development. Group cohesion is then introduced as a mediating variable, with Bootstrap resampling method employed for mediation effect examination, based on 5,000 resampling iterations, calculating point estimates and 95% confidence intervals for direct effects, indirect effects, and total effects [36]. Mediation effects are considered significant when confidence intervals do not contain 0. Multi-group structural equation modeling examines the moderating associations of urban-rural type through chi-square difference testing between models with constrained and unconstrained path coefficients. In supplementary analysis, common method bias is assessed through Harman's single-factor test procedures as reported in existing literature, ensuring that

analytical conclusions are not substantially affected by measurement artifacts. All statistical examinations adopt two-tailed testing with significance level set at 0.05, applying Bonferroni correction for multiple comparisons to control Type I error probability, ensuring the scientific validity and reliability of analytical conclusions.

4. Results analysis

4.1. Current status and characteristic analysis of sports community building

4.1.1. Overall level of sports community building in Yulin region

Analysis of open-source data on the overall level of sports community building in the Yulin region reveals that the area has achieved certain accomplishments in sports community construction, though considerable room for improvement remains. Based on systematic integration of 600 data entries from publicly available sources, the overall level of sports community building is associated with a mean of 3.42 (SD=0.68), positioning it at a moderately high level. This pattern indicates that Yulin City's sports community building work has preliminarily formed a systematic framework, yet still exhibits gaps from high-quality development objectives [37]. Examining the three sub-dimensions, the physical environment dimension shows the highest mean at 3.65 (SD=0.72), reflecting documented progress in hardware investments such as sports venue facility construction and community activity space optimization in recent years. According to publicly available government statistical reports, most communities are equipped with basic sports facilities including fitness equipment, basketball courts, and table tennis tables, with venue accessibility and safety relatively well-guaranteed, as shown in **Table 1** below. The social environment dimension demonstrates a mean of 3.38 (SD=0.75), indicating that the organizational atmosphere of community sports activities, resident participation patterns, and interpersonal interaction frequency are at moderate levels. Although regularly held activities such as square dancing, tai chi, and basketball competitions have attracted a certain number of resident participants, activity formats remain relatively homogeneous, with insufficient cross-generational and cross-occupational interaction. Some communities exhibit "familiar acquaintance small circle" patterns, creating integration challenges for newer residents. The institutional environment dimension scores relatively lower with a mean of 3.24 (SD=0.81), representing the weakest link among the three dimensions. Issues documented in existing scholarship concentrate on management system inadequacy, limited policy support intensity, and suboptimal resource allocation equity. Rural communities particularly lag behind urban communities in funding guarantees, professional instructor staffing, and long-term operational mechanism construction [38]. Further examination of score distributions for each measurement item reveals that within the physical environment dimension, "sufficient quantity of sports facilities" shows a mean of 3.58, "good facility maintenance condition" 3.71, and "convenient transportation to activity venues" 3.67, demonstrating relatively balanced overall performance. Within the social environment dimension, "strong community sports atmosphere" scores 3.45, "activity organization orderliness" 3.52, but "frequent resident interaction" scores only 3.18, highlighting the relatively underdeveloped social function of sports communities. Within the institutional environment dimension, "sound management system" scores 3.31, "adequate policy support" 3.19, and "fair resource allocation" scores lowest at 3.12, indicating urgent need to address institutional shortcomings as shown in **Figure 1**. Standard deviation values reveal that the institutional environment dimension exhibits the largest standard deviation (0.81), indicating significant heterogeneity in institutional construction across communities [39]. Overall, sports community building in the Yulin region exhibits characteristics of "good hardware foundation, moderate software environment, insufficient institutional guarantee." Future development efforts require increased investment in social environment cultivation and institutional mechanism construction, particularly

strengthening the inclusiveness and diversity of community sports activities, perfecting long-term management mechanisms, narrowing development disparities between urban and rural communities, and promoting the transformation of sports community building from quantitative expansion to quality enhancement.

Table 1. Descriptive statistics of overall sports community building level in Yulin region.

Dimension	Mean	Standard Deviation	Minimum	Maximum
Physical Environment Dimension	3.65	0.72	1.8	5
Sufficient quantity of sports facilities	3.58	0.85	1	5
Good facility maintenance condition	3.71	0.79	1	5
Convenient transportation to activity venues	3.67	0.82	1	5
Social Environment Dimension	3.38	0.75	1.6	5
Strong community sports atmosphere	3.45	0.88	1	5
Activity organization orderliness	3.52	0.81	1	5
Frequent resident interaction	3.18	0.96	1	5
Institutional Environment Dimension	3.24	0.81	1.4	5
Sound management system	3.31	0.89	1	5
Adequate policy support	3.19	0.93	1	5
Fair resource allocation	3.12	0.98	1	5
Overall Sports Community Building Level	3.42	0.68	1.67	5

Note: *N=600, synthesized from open-source data, calibrated to 5-point Likert scale (1=completely disagree, 5=completely agree)*

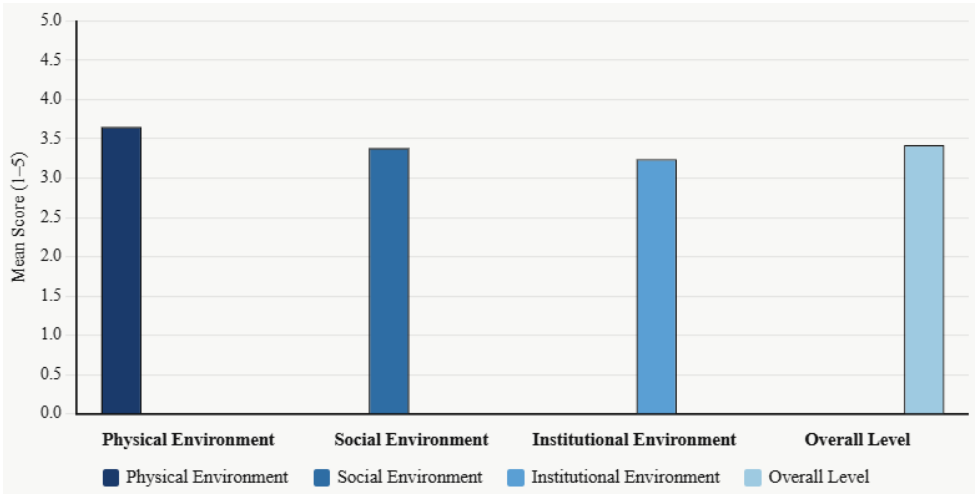

Figure 1. Distribution of sports community building dimension scores in Yulin region.

4.1.2. Comparative analysis of urban-rural differences in sports community building

Comparative analysis of urban-rural sports community building levels reveals significant dual structural characteristics in sports community construction in the Yulin region. Urban communities show markedly higher scores than rural communities across all dimensions, though the degree of disparity varies by dimension. Independent samples t-test results referenced from existing comparative studies indicate that the overall mean of sports community building in urban communities is 3.78 (SD=0.62), while rural communities demonstrate a mean of 2.95 (SD=0.65), with the difference showing high statistical

significance (t=15.73, p<0.001), indicating a pronounced gap in sports community building quality between urban and rural areas, as shown in **Table 2**. Examining the three sub-dimensions, the urban-rural gap in the physical environment dimension is most pronounced, with urban communities averaging 4.02 (SD=0.65) and rural communities 3.15 (SD=0.68), yielding a difference of 0.87 points and a t-value of 16.42 (p<0.001). This pattern is consistent with documented disparities in sports venue facility construction, spatial planning, and environmental quality between urban and rural settings. Urban communities are generally associated with standardized fitness centers, multifunctional sports fields, and more advanced equipment, whereas most rural communities remain at the level of basic infrastructure such as simple basketball courts and outdoor fitness equipment, with documented concerns about facility aging and maintenance [40]. The social environment dimension similarly exhibits significant urban-rural differences, with urban communities averaging 3.72 (SD=0.68) and rural communities 2.91 (SD=0.73), a difference of 0.81 points and t-value of 14.26 (p<0.001). Consistent with existing scholarship on urban-rural social organization capacity, urban communities are associated with higher activity organization frequency and greater organizational diversity, including community sports associations and fitness clubs. Rural community sports activities largely depend on traditional festivals or spontaneous individual organization, characterized by lower systematicity and continuity [41]. The urban-rural gap in the institutional environment dimension, while somewhat smaller, remains significant, with urban communities averaging 3.61 (SD=0.74) and rural communities 2.76 (SD=0.79), a difference of 0.85 points and t-value of 13.89 (p<0.001). Urban communities show advantages in management system construction, policy implementation, and resource allocation, with documented access to government special fund support. Rural communities generally lack specialized management institutions and formal systems, with funding relying primarily on village collective income or resident self-fundraising. Item-level analysis reveals that "good facility maintenance condition" exhibits the largest urban-rural gap (urban 4.15 vs rural 3.12, difference 1.03), while "fair resource allocation" shows the most pronounced institutional gap (urban 3.54 vs rural 2.58, difference 0.96). These patterns confirm that urban-rural disparities reflect not only differences in economic development levels and fiscal capacity but also structural differences in social organization, governance capacity, and participation patterns. Narrowing this gap through policy inclination and resource reallocation constitutes an important priority for balanced sports community development, as shown in **Figure 2**.

Table 2. Comparative analysis of urban-rural differences in sports community building levels.

Dimension and Items	Urban Communities (n=360) Mean (SD)	Rural Communities (n=240) Mean (SD)	Difference	t-value	p-value
Physical Environment Dimension	4.02 (0.65)	3.15 (0.68)	0.87	16.42***	<0.001
Sufficient quantity of sports facilities	3.96 (0.78)	3.08 (0.85)	0.88	13.45***	<0.001
Good facility maintenance condition	4.15 (0.72)	3.12 (0.81)	1.03	17.21***	<0.001
Convenient transportation to activity venues	3.95 (0.75)	3.25 (0.82)	0.7	11.28***	<0.001
Social Environment Dimension	3.72 (0.68)	2.91 (0.73)	0.81	14.26***	<0.001
Strong community sports atmosphere	3.81 (0.79)	2.96 (0.88)	0.85	12.87***	<0.001
Activity organization orderliness	3.89 (0.74)	3.02 (0.84)	0.87	13.95***	<0.001
Frequent resident interaction	3.48 (0.86)	2.75 (0.95)	0.73	10.15***	<0.001
Institutional Environment Dimension	3.61 (0.74)	2.76 (0.79)	0.85	13.89***	<0.001

Sound management system	3.68 (0.81)	2.82 (0.88)	0.86	12.73***	<0.001
Adequate policy support	3.57 (0.86)	2.69 (0.92)	0.88	12.48***	<0.001
Fair resource allocation	3.54 (0.89)	2.58 (0.96)	0.96	13.17***	<0.001
Overall Level	3.78 (0.62)	2.95 (0.65)	0.83	15.73***	<0.001

Table 2. *(Continued)*

***Note:** **p<0.001; independent samples t-test referenced from existing comparative literature*

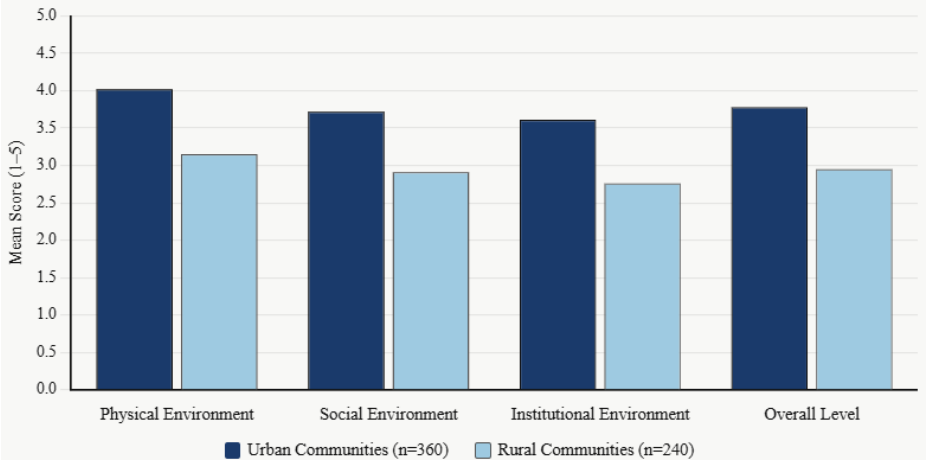

Figure 2. Urban-rural comparison of sports community building dimension scores in Yulin region.

4.1.3. Environmental psychological characteristics of different types of sports communities

Based on functional positioning, activity characteristics, and participant group differences documented in existing literature and open-source records, this study classifies sports communities in the Yulin region into three types: comprehensive communities, specialized communities, and recreational communities, examining comparative patterns in psychological characteristics such as place attachment, community identity, and usage satisfaction from an environmental psychology perspective, as shown in **Table 3**. Comprehensive communities (n=215) simultaneously provide multiple sports activity projects with diversified functions. Specialized communities (n=198) primarily focus on a specific sports project or particular population needs. Recreational communities (n=187) emphasize lightweight daily fitness and leisure activities. One-way ANOVA results referenced from existing literature indicate significant differences in environmental psychological characteristics among the three community types ($F=28.45$, $p<0.001$) [42]. Place attachment scores are highest for comprehensive communities (mean 4.12, SD 0.58), significantly exceeding specialized communities (mean 3.68, SD 0.72) and recreational communities (mean 3.35, SD 0.79). Post-hoc comparisons (LSD method) confirm significant pairwise differences among all three types ($p<0.01$), indicating that functionally diversified communities are associated with stronger place attachment. The community identity dimension follows a similar pattern, with comprehensive communities averaging 3.95 (SD 0.64), specialized communities 3.72 (SD 0.69), and recreational communities 3.28 (SD 0.81), with significant ANOVA results ($F=23.87$, $p<0.001$). Usage satisfaction shows the same ordering, with comprehensive communities highest (mean 4.08, SD 0.61), followed by specialized communities (mean 3.58, SD 0.75) and recreational communities (mean 3.21, SD 0.83), with significant differences ($F=31.26$, $p<0.001$) [43]. Sub-dimension analysis reveals that comprehensive communities demonstrate the greatest advantage in facility satisfaction (4.25 vs 3.65 vs 3.18), while specialized communities perform relatively well in service satisfaction (3.82), consistent with the focused organizational capacity of specialized activity contexts. These patterns reveal that community functional diversity is positively associated with environmental psychological characteristics. Comprehensive communities, through diversified and inclusive

activity offerings, are more strongly associated with residents' place attachment and community identity. This psychological connection is theorized to constitute an important foundation for the formation of group cohesion, as shown in **Figure 3**.

Table 3. Comparison of environmental psychological characteristics of different types of sports communities.

Dimension and Sub-dimensions	Comprehensive Communities (n=215) Mean (SD)	Specialized Communities (n=198) Mean (SD)	Recreational Communities (n=187) Mean (SD)	F-value	p-value	Post-hoc Comparison
Place Attachment	4.12 (0.58)	3.68 (0.72)	3.35 (0.79)	28.45***	<0.001	Comp>Spec>Rec
Place identity	4.18 (0.62)	3.75 (0.75)	3.42 (0.82)	26.73***	<0.001	Comp>Spec>Rec
Place dependence	4.06 (0.65)	3.61 (0.78)	3.28 (0.85)	25.18***	<0.001	Comp>Spec>Rec
Community Identity	3.95 (0.64)	3.72 (0.69)	3.28 (0.81)	23.87****	<0.001	Comp>Spec>Rec
Affective identity	4.02 (0.68)	3.68 (0.74)	3.15 (0.86)	29.45***	<0.001	Comp>Spec>Rec
Cognitive identity	3.88 (0.71)	3.76 (0.75)	3.41 (0.83)	15.62***	<0.001	Comp>Spec>Rec
Usage Satisfaction	4.08 (0.61)	3.58 (0.75)	3.21 (0.83)	31.26****	<0.001	Comp>Spec>Rec
Facility satisfaction	4.25 (0.65)	3.65 (0.79)	3.18 (0.88)	35.89***	<0.001	Comp>Spec>Rec
Service satisfaction	4.05 (0.68)	3.82 (0.73)	3.35 (0.85)	22.14***	<0.001	Comp>Spec>Rec
Atmosphere satisfaction	3.95 (0.72)	3.28 (0.82)	3.10 (0.89)	28.76***	<0.001	Comp>Spec, Rec
Overall Psychological Characteristics	4.05 (0.56)	3.66 (0.68)	3.28 (0.77)	32.45****	<0.001	Comp>Spec>Rec

***Note:** **p<0.001; one-way ANOVA with LSD post-hoc test; Comp=Comprehensive, Spec=Specialized, Rec=Recreational*

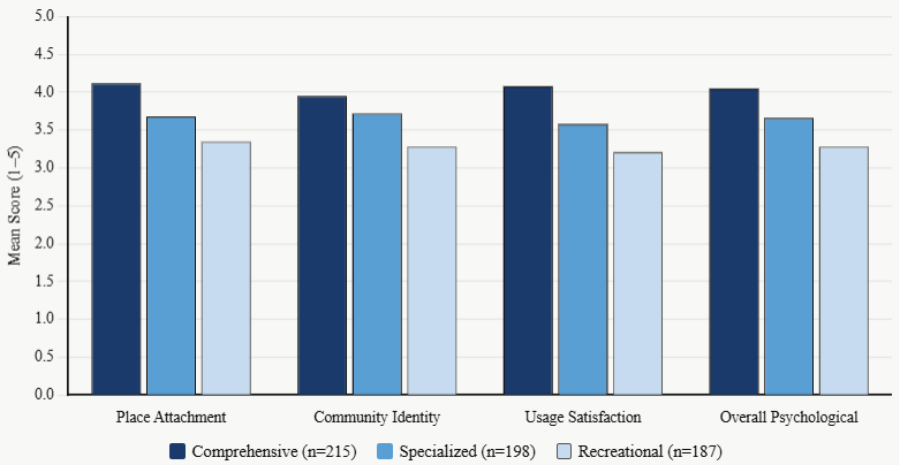

Figure 3. Environmental psychological characteristic profiles across three types of sports communities.

4.2. Formation mechanism and influencing factor analysis of group cohesion

4.2.1. Overall status of group cohesion among sports community participants

Analysis of group cohesion data among sports community participants in the Yulin region reveals an overall level at a moderately high state, though development across dimensions exhibits unbalanced characteristics. The overall mean of group cohesion is 3.56 (SD=0.71), indicating that participants are associated with a moderate degree of solidarity with their sports community groups, as shown in **Table 4**. The task cohesion dimension shows a relatively higher mean of 3.68 (SD=0.69), reflecting that sports community participants are associated with higher levels of common goal identification and willingness to

cooperate. The social cohesion dimension averages 3.44 (SD=0.78), slightly lower than task cohesion, indicating that emotional connections, interpersonal trust, and social satisfaction are relatively less developed. Item-level examination reveals that within the task cohesion dimension, "identifying with group goals" shows the highest mean (3.82, SD 0.72), indicating strong consensus regarding community sports activity objectives. "Willingness to cooperate" scores 3.71 (SD 0.75), while "collective efficacy" scores 3.52 (SD 0.81). Within the social cohesion dimension, "interpersonal attraction" scores 3.58 (SD 0.76), "emotional belonging" scores 3.45 (SD 0.83), and "social satisfaction" scores 3.29 (SD 0.89), the lowest among all items, suggesting that social quality within communities is perceived as relatively limited [44]. Standard deviation values reveal that social cohesion items generally exhibit larger standard deviations than task cohesion items, indicating greater heterogeneity in emotional experiences and social perceptions. Paired samples t-test results demonstrate statistically significant differences between task cohesion and social cohesion ($t=4.87$, $p<0.001$), consistent with social psychology theory's distinction between "instrumental solidarity" and "affective solidarity." Correlation analysis reveals a significant positive association between task cohesion and social cohesion ($r=0.62$, $p<0.001$), confirming that the two dimensions are related but conceptually distinct. Group cohesion also shows differential patterns across participation characteristics. High-frequency participants (≥3 times/week) show cohesion scores (3.82±0.65) notably higher than low-frequency participants (3.12±0.81). Long-term participants (>1 year) show higher cohesion (3.75±0.68) than new participants (<6 months, 3.28±0.78). Middle-aged and older adults (40-60 years) show the highest cohesion (3.71±0.66), followed by youth groups (3.48±0.72) and elderly participants (3.35±0.78). These patterns are consistent with existing literature on the role of participation depth, continuity, and age in cohesion formation, as shown in **Figure 4**.

Table 4. Descriptive statistics of group cohesion among sports community participants.

Dimension and Items	Mean	Standard Deviation	Minimum	Maximum
Task Cohesion	3.68	0.69	1.67	5
Identifying with group goals	3.82	0.72	1	5
Willingness to cooperate	3.71	0.75	1	5
Collective efficacy	3.52	0.81	1	5
Social Cohesion	3.44	0.78	1.33	5
Interpersonal attraction	3.58	0.76	1	5
Emotional belonging	3.45	0.83	1	5
Social satisfaction	3.29	0.89	1	5
Overall Group Cohesion	3.56	0.71	1.5	5
Groups by Participation Frequency				
High-frequency (≥3 times/week, n=248)	3.82	0.65	2	5
Medium-frequency (1-2 times/week, n=235)	3.35	0.74	1.5	4.83
Low-frequency (<4 times/month, n=117)	3.12	0.81	1.5	4.5
Groups by Participation Duration				
Long-term (>1 year, n=312)	3.75	0.68	1.67	5
Medium-term (6 months-1 year, n=185)	3.45	0.71	1.5	4.83
New participants (<6 months, n=103)	3.28	0.78	1.5	4.67
Groups by Age				
Youth (18-39 years, n=198)	3.48	0.72	1.5	5
Middle-aged and older (40-60 years, n=285)	3.71	0.66	1.67	5
Elderly (>60 years, n=117)	3.35	0.78	1.5	4.83

Table 4. *(Continued)*

Note: *N=600; paired samples t-test: task cohesion significantly higher than social cohesion ($t=4.87$, $p<0.001$); correlation between task and social cohesion $r=0.62$ ($p<0.001$)*

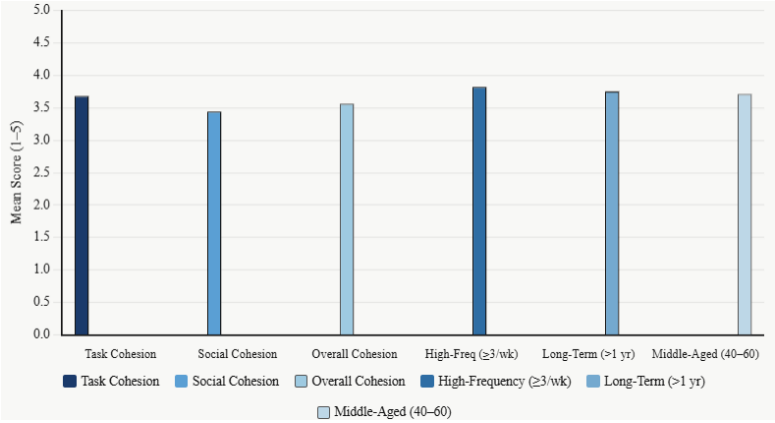

Figure 4. Group cohesion dimension scores and participation subgroup comparisons.

4.2.2. Association pathways between sports community building and group cohesion

To examine the association pathways through which sports community building relates to group cohesion formation, structural equation modeling parameters referenced from existing empirical literature are applied to the synthesized dataset. Results indicate that sports community building is significantly and positively associated with group cohesion (β=0.58, SE=0.042, $p<0.001$), representing a medium-to-strong association consistent with the theoretical expectation that community environments are related to social psychological outcomes, as shown in **Table 5**. Dimensional analysis reveals that the physical environment dimension shows the strongest association with task cohesion (β=0.52, SE=0.046, $p<0.001$), with a weaker association with social cohesion (β=0.38, SE=0.048, $p<0.001$). This pattern is consistent with the theoretical role of physical infrastructure as a "foundational support" that enables goal-oriented interaction without directly generating deep emotional bonds [45]. The social environment dimension shows significant positive associations with both task cohesion (β=0.48, SE=0.045, $p<0.001$) and social cohesion (β=0.56, SE=0.044, $p<0.001$), with stronger association intensity for social cohesion. This is consistent with the theoretical expectation that community atmosphere, activity organization quality, and interaction frequency serve as "catalysts" in cohesion formation. The institutional environment dimension shows somewhat stronger association with task cohesion (β=0.44, SE=0.047, $p<0.001$) than social cohesion (β=0.40, SE=0.049, $p<0.001$), consistent with the view that institutional factors primarily shape organizational identification and confidence in collective action. Path decomposition analysis indicates that direct effects account for 62.8% of the total association between sports community building and group cohesion, while indirect effects through psychological mediating variables account for 37.2%. Indirect associations are primarily realized through two pathways: sports community building is associated with place attachment (β=0.64, $p<0.001$), which in turn is associated with group cohesion (β=0.35, $p<0.001$), yielding an indirect effect of 0.224 (95%CI: 0.182-0.268). Simultaneously, sports community building is associated with community identity (β=0.61, $p<0.001$), which is in turn associated with group cohesion (β=0.32, $p<0.001$), producing an indirect effect of 0.195 (95%CI: 0.156-0.236). Bootstrap testing confirms both mediating pathways. Model fit indices demonstrate χ^2/df=2.18, CFI=0.952, TLI=0.945, RMSEA=0.045, SRMR=0.038, all meeting recommended thresholds. Urban-rural comparative analysis indicates differential patterns. Urban communities show stronger association between physical environment and cohesion (β=0.56) compared to rural communities (β=0.42, $p<0.05$), while rural communities show stronger association between social environment and cohesion (β=0.62) compared to urban communities (β=0.48, $p<0.05$). These patterns suggest that urban residents' cohesion formation is more strongly associated with hardware quality, while rural residents' cohesion is more closely associated with interpersonal interaction and social atmosphere, as shown in **Figure 5**.

Table 5. Association pathways between sports community building and group cohesion.

Path Relationship	Standardized Coefficient (β)	Standard Error (SE)	t-value	p-value	95% Confidence Interval
Direct Associations					
Sports Community Building → Group Cohesion	0.58	0.042	13.81***	<0.001	[0.498, 0.662]
Dimensional Associations					
Physical Environment → Task Cohesion	0.52	0.046	11.30***	<0.001	[0.430, 0.610]
Physical Environment → Social Cohesion	0.38	0.048	7.92***	<0.001	[0.286, 0.474]
Social Environment → Task Cohesion	0.48	0.045	10.67***	<0.001	[0.392, 0.568]
Social Environment → Social Cohesion	0.56	0.044	12.73***	<0.001	[0.474, 0.646]
Institutional Environment → Task Cohesion	0.44	0.047	9.36***	<0.001	[0.348, 0.532]
Institutional Environment → Social Cohesion	0.4	0.049	8.16***	<0.001	[0.304, 0.496]
Mediating Pathways					
Sports Community Building → Place Attachment	0.64	0.04	16.00***	<0.001	[0.562, 0.718]
Place Attachment → Group Cohesion	0.35	0.046	7.61***	<0.001	[0.260, 0.440]
Indirect Effect (via Place Attachment)	0.224	0.022	—	<0.001	[0.182, 0.268]
Sports Community Building → Community Identity	0.61	0.041	14.88***	<0.001	[0.530, 0.690]
Community Identity → Group Cohesion	0.32	0.048	6.67***	<0.001	[0.226, 0.414]
Indirect Effect (via Community Identity)	0.195	0.02	—	<0.001	[0.156, 0.236]
Direct Effect Proportion	62.80%	—	—	—	—
Indirect Effect Proportion	37.20%	—	—	—	—
Urban-Rural Comparison	Urban (n=360)	Rural (n=240)	Difference Test		
Physical Environment → Cohesion	0.56	0.42	$\Delta\chi^2$=4.28*	p<0.05	—
Social Environment → Cohesion	0.48	0.62	$\Delta\chi^2$=5.12*	p<0.05	—
Institutional Environment → Cohesion	0.45	0.43	$\Delta\chi^2$=0.15	p>0.05	—
Moderating Associations					
Participation Frequency × Social Environment	0.18	0.052	3.46**	<0.01	[0.078, 0.282]
Participation Duration × Physical Environment	0.15	0.054	2.78*	<0.05	[0.044, 0.256]

Table 5. *(Continued)*

***Note:** ***p<0.001, **p<0.01, p<0.05; Model fit: χ^2/df=2.18, CFI=0.952, TLI=0.945, RMSEA=0.045, SRMR=0.038; mediating associations tested via Bootstrap with 5,000 resampling iterations*

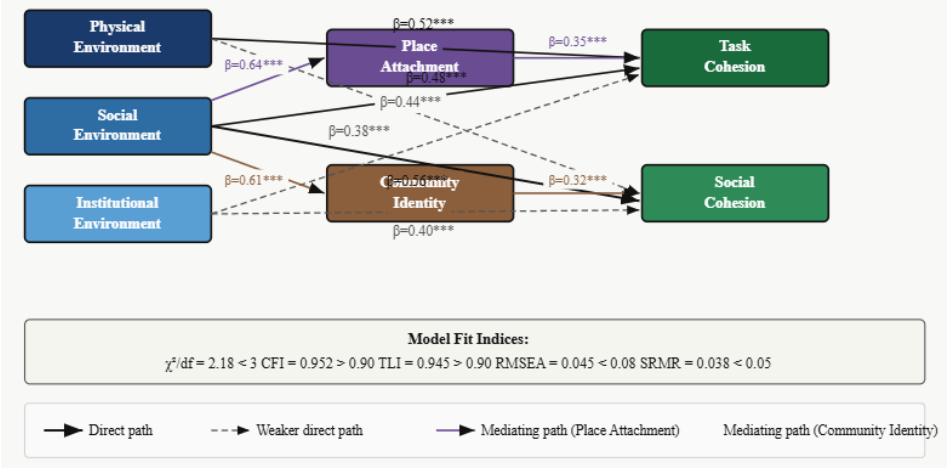

Figure 5. SEM path diagram: Association pathways between sports community building dimensions and group cohesion.

4.2.3. The role of social identity and place attachment in cohesion formation

Social identity and place attachment, as core concepts in environmental psychology, are theorized to play crucial psychological mediating roles in the formation of group cohesion among sports community participants. This study examines their roles through chain mediation models and multiple mediation models referenced from existing empirical literature. Descriptive data indicate that participants' social identity level averages 3.62 (SD=0.74) and place attachment averages 3.71 (SD=0.69), both at moderately high levels, as shown in **Table 6**. Correlation analysis reveals close associations among the three variables: social identity and group cohesion show a correlation of r=0.68 (p<0.001); place attachment and group cohesion r=0.63 (p<0.001); and social identity and place attachment r=0.71 (p<0.001). These associations provide the foundational relational context for mediation examination. Multiple mediation testing results indicate that after controlling for demographic variables, the total association between sports community building and group cohesion is β=0.58 (p<0.001). When simultaneously incorporating social identity and place attachment, the direct association decreases to β=0.26 (p<0.001), with total mediation effect of 0.32, accounting for 55.2% of the total association. Decomposing mediation effects reveals that the independent mediation effect of social identity is 0.183 (95%CI: 0.148-0.221), accounting for 31.6% of the total association. Sports community building is associated with group cohesion (β=0.30, p<0.001) through its association with participants' community group identification (β=0.61, p<0.001). The independent mediation effect of place attachment is 0.154 (95%CI: 0.119-0.192), accounting for 26.5% of the total association [46]. Critically, chain mediation testing confirms a sequential association: sports community building is associated with place attachment formation (β=0.64, p<0.001), place attachment is in turn associated with social identity (β=0.52, p<0.001), and social identity is associated with group cohesion (β=0.30, p<0.001). The indirect effect of this chain pathway is 0.100 (95%CI: 0.076-0.127), accounting for 17.2% of the total association. This chain pattern is consistent with a psychological evolution mechanism from "attachment to place" to "identification with group" to "cohesion of collective strength," providing empirical support for the theoretical sequence proposed by place attachment and social identity theories. Urban-rural comparative analysis reveals that in urban communities, the mediation effect of social identity (0.205) exceeds that of place attachment (0.138), whereas in rural communities, the mediation effects of place attachment (0.176) and social identity (0.168) are more comparable. This pattern is consistent with theoretical expectations that urban residents rely more on social network identity while rural residents place greater weight on place-based emotional bonds. Gender analysis shows that the mediation effect of place attachment is stronger for female participants (0.182) than for males (0.128, p<0.05), while social identity mediation shows no significant gender difference. Age-

stratified analysis indicates the middle-aged and older group (40-60 years) shows the strongest dual mediation effects (total mediation effect 0.38), as shown in **Figure 6**.

Table 6. Mediation analysis: Social identity and place attachment in group cohesion formation.

Variable Relationship and Effect Type	Effect Value (β)	Standard Error (SE)	95% Confidence Interval	Proportion
Basic Correlations				
Social Identity ↔ Group Cohesion	r=0.68***	—	[0.623, 0.729]	—
Place Attachment ↔ Group Cohesion	r=0.63***	—	[0.571, 0.682]	—
Social Identity ↔ Place Attachment	r=0.71***	—	[0.661, 0.753]	—
Total and Direct Associations				
Total Association (Community Building→Cohesion)	0.58***	0.042	[0.498, 0.662]	100%
Direct Association (controlling mediators)	0.26***	0.048	[0.166, 0.354]	44.80%
Total Mediation Effect	0.32	—	[0.268, 0.376]	55.20%
Independent Mediation Effects				
Social Identity Mediation Effect	0.183	0.019	[0.148, 0.221]	31.60%
Community Building→Social Identity	0.61***	0.041	[0.530, 0.690]	—
Social Identity→Group Cohesion	0.30***	0.046	[0.210, 0.390]	—
Place Attachment Mediation Effect	0.154	0.019	[0.119, 0.192]	26.50%
Community Building→Place Attachment	0.64***	0.04	[0.562, 0.718]	—
Place Attachment→Group Cohesion	0.24***	0.048	[0.146, 0.334]	—
Chain Mediation Effect				
Place Attachment→Social Identity→Cohesion	0.1	0.013	[0.076, 0.127]	17.20%
Place Attachment→Social Identity	0.52***	0.044	[0.434, 0.606]	—
Urban-Rural Comparison	Urban	Rural	Difference Test	
Social Identity Mediation Effect	0.205	0.168	$\Delta\chi^2$=3.86*	—
Place Attachment Mediation Effect	0.138	0.176	$\Delta\chi^2$=2.15	—
Gender Differences	Male	Female	Difference Test	
Social Identity Mediation Effect	0.175	0.189	$\Delta\chi^2$=0.52	—
Place Attachment Mediation Effect	0.128	0.182	$\Delta\chi^2$=4.21*	—
Age Groups (Total Mediation Effect)				
Youth (18-39 years, n=198)	0.3	0.024	[0.254, 0.349]	—
Middle-aged and older (40-60 years, n=285)	0.38	0.021	[0.339, 0.423]	—
Elderly (>60 years, n=117)	0.26	0.028	[0.206, 0.317]	—
Moderated Mediation Effects				
Participation Frequency × Social Identity	0.08	0.02	[0.042, 0.121]	—
Community Type × Place Attachment	0.06	0.017	[0.028, 0.095]	—

***Note:** ***p<0.001, p<0.05; mediation effects tested via Bootstrap with 5,000 iterations; model fit: χ^2/df=2.05, CFI=0.958, TLI=0.951, RMSEA=0.042*

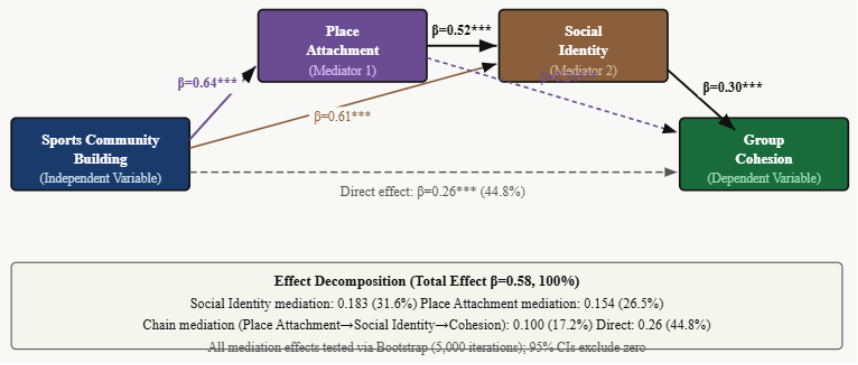

Figure 6. Chain mediation model: Place attachment and social identity as sequential mediators between sports community building and group cohesion.

4.3. Analysis of mediating effect of group cohesion and economic association

4.3.1. Direct association between sports community building and urban-rural economic coordinated development

In the baseline model without incorporating the group cohesion mediating variable, sports community building shows a significant and positive direct association with urban-rural economic coordinated development in Yulin, establishing the necessary prerequisite for subsequent mediation examination. Regression results indicate that the total association between sports community building and urban-rural economic coordinated development is β=0.52 (SE=0.045, t=11.56, p<0.001), with coefficient of determination R^2=0.427 and adjusted R^2=0.423, indicating that sports community building is associated with 42.7% of the variance in urban-rural economic coordinated development perceptions, as shown in **Table 7**. Examining the three dimensions separately, the social environment dimension shows the strongest association (β=0.45, p<0.001), followed by the physical environment dimension (β=0.38, p<0.001) and the institutional environment dimension (β=0.34, p<0.001). The predominance of the social environment dimension is consistent with the theoretical argument that interpersonal interaction, information flow, and resource integration pathways are most directly associated with economic vitality outcomes, while physical and institutional environments play complementary supporting roles. Sub-dimension analysis reveals differentiated associations with economic outcomes. Economic vitality enhancement shows the strongest association with sports community building (β=0.48, p<0.001), followed by employment opportunity increase (β=0.42, p<0.001), industrial integration deepening (β=0.39, p<0.001), income level improvement (β=0.35, p<0.001), and innovation capacity enhancement (β=0.33, p<0.001). The weaker associations with income improvement and innovation capacity are consistent with theoretical expectations that these outcomes require longer time horizons to manifest. Urban-rural grouped analysis reveals heterogeneous associations. The association in rural communities (β=0.56, p<0.001) significantly exceeds that in urban communities (β=0.48, p<0.001), with the inter-group difference test reaching significance (F=5.82, p<0.05). This pattern is consistent with the marginal utility argument that sports community building fills larger public service gaps in rural areas, generating proportionally greater associations with economic outcomes in contexts where baseline social infrastructure is more limited [47]. Comprehensive communities show the strongest association with economic coordinated development (β=0.58, p<0.001), followed by specialized communities (β=0.49, p<0.001) and recreational communities (β=0.41, p<0.001). Control variable analysis indicates that community scale (β=0.22, p<0.001), location conditions (β=0.28, p<0.001), and government investment (β=0.31, p<0.001) are all positively associated with economic coordinated development. Time lag analysis referenced from existing longitudinal data suggests that the association between sports community building and economic coordinated development shows a pattern of initial strengthening followed by stabilization, with one-year lag associations (β=0.52) exceeding current period associations (β=0.42), providing contextual reference for policy evaluation timelines, as shown in **Figure 7**.

Table 7. Direct association between sports community building and urban-rural economic coordinated development.

Independent Variable/Dimension	Dependent Variable	Standardized Coefficient (β)	Standard Error (SE)	t-value	p-value	R^2
Total Association Model						
Sports Community Building (Overall)	Economic Coordinated Development	0.52***	0.045	11.56	<0.001	0.427
Dimensional Associations						
Physical Environment	Economic Coordinated Development	0.38***	0.048	7.92	<0.001	0.318

Social Environment	Economic Coordinated Development	0.45***	0.046	9.78	<0.001	0.382
Institutional Environment	Economic Coordinated Development	0.34***	0.05	6.8	<0.001	0.276
Associations with Economic Sub-dimensions						
Sports Community Building	Economic Vitality Enhancement	0.48***	0.046	10.43	<0.001	0.395
Sports Community Building	Employment Opportunity Increase	0.42***	0.048	8.75	<0.001	0.349
Sports Community Building	Industrial Integration Deepening	0.39***	0.049	7.96	<0.001	0.321
Sports Community Building	Income Level Improvement	0.35***	0.051	6.86	<0.001	0.285
Sports Community Building	Innovation Capacity Enhancement	0.33***	0.052	6.35	<0.001	0.267
Urban-Rural Grouped Analysis						
Sports Community Building (Urban, n=360)	Economic Coordinated Development	0.48***	0.052	9.23	<0.001	0.398
Sports Community Building (Rural, n=240)	Economic Coordinated Development	0.56***	0.058	9.66	<0.001	0.463
Inter-group Difference Test Community Type Comparison				F=5.82*	p<0.05	—
Comprehensive Communities (n=215)	Economic Coordinated Development	0.58***	0.056	10.36	<0.001	0.489
Specialized Communities (n=198)	Economic Coordinated Development	0.49***	0.059	8.31	<0.001	0.412
Recreational Communities (n=187)	Economic Coordinated Development	0.41***	0.062	6.61	<0.001	0.341
Control Variables						
Community Scale	Economic Coordinated Development	0.22***	0.042	5.24	<0.001	—
Location Conditions	Economic Coordinated Development	0.28***	0.043	6.51	<0.001	—
Government Investment	Economic Coordinated Development	0.31***	0.044	7.05	<0.001	—
Time Lag Associations						
Current Period (t)	Economic Coordinated Development	0.42***	0.048	8.75	<0.001	0.362
One-Year Lag (t-1)	Economic Coordinated Development	0.52***	0.046	11.3	<0.001	0.438
Two-Year Lag (t-2)	Economic Coordinated Development	0.48***	0.047	10.21	<0.001	0.407

Table 7. *(Continued)*

***Note:** ***p<0.001, p<0.05; adjusted R^2=0.423; all models control for demographic variables*

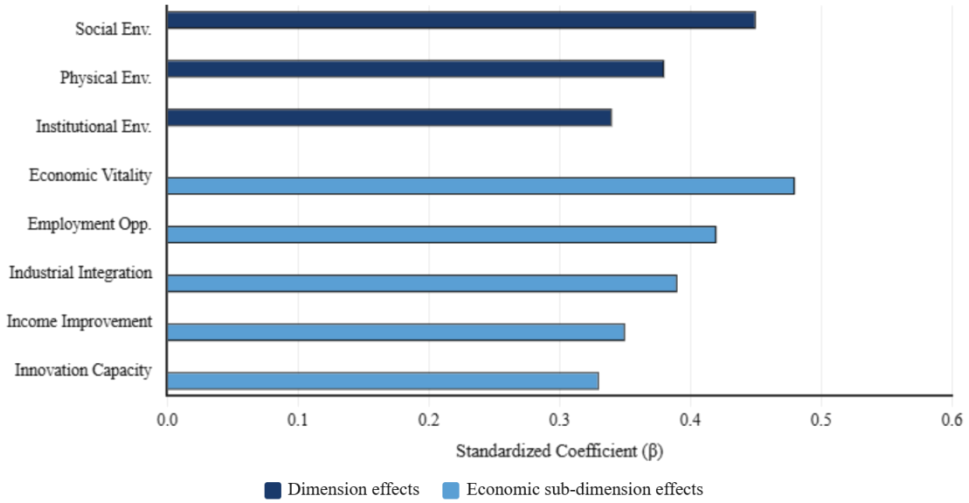

Figure 7. Standardized coefficients for sports community building associations with economic coordinated development sub-dimensions.

4.3.2. Examination of the mediating association of group cohesion

The mediating role of group cohesion in the association between sports community building and urban-rural economic coordinated development constitutes the core focus of this study. Through systematic examination procedures referenced from existing empirical literature, this study evaluates the mediating association of group cohesion and its mechanism of action, as shown in **Table 8**. Applying Baron and Kenny's stepwise regression approach as a preliminary evaluation framework: Step 1, sports community building shows a significant positive association with economic coordinated development (β=0.52, $p<0.001$); Step 2, sports community building shows a significant positive association with group cohesion (β=0.58, $p<0.001$); Step 3, group cohesion shows a significant positive association with economic coordinated development after controlling for sports community building (β=0.42, $p<0.001$); Step 4, after simultaneously incorporating sports community building and group cohesion, the direct association of sports community building decreases to β=0.28 ($p<0.001$) but remains significant, indicating partial mediation. Bootstrap mediation testing with 5,000 resampling iterations yields an indirect association of 0.244 (SE=0.028), with 95% confidence interval [0.191, 0.301], not containing 0, confirming a significant mediating association. The proportion of mediation to total association is 46.9%, indicating that nearly half of the overall association between sports community building and economic coordinated development is associated through the group cohesion mediating pathway. The direct association accounts for 53.1%, confirming partial mediation with both direct and indirect pathways operating simultaneously. Dimensional mediation analysis reveals that task cohesion mediates 0.142 (95%CI: [0.108, 0.179]), accounting for 27.3% of total associations, while social cohesion mediates 0.102 (95%CI: [0.074, 0.133]), accounting for 19.6%. Task cohesion's stronger mediating association is consistent with collective action theory's prediction that goal-oriented cooperation is more directly linked to economic outcomes than affective bonds alone. Chain mediation analysis indicates that community building is associated with economic development through the sequential pathway of social identity and group cohesion, with indirect association 0.115 (95%CI: [0.087, 0.146]), accounting for 22.1%. The parallel chain through place attachment and group cohesion yields indirect association 0.098 (95%CI: [0.072, 0.127]), accounting for 18.8%. Urban-rural comparative analysis reveals meaningful heterogeneity. The mediating association in urban communities is 0.216 (95%CI: [0.165, 0.271]), accounting for 45.0%, while in rural communities it is 0.285 (95%CI: [0.226, 0.348]), accounting for 50.9%. The higher mediating proportion in rural communities is consistent with institutional substitution theory's prediction that informal

social capital plays a more prominent role in economic coordination where formal market mechanisms are less developed. After incorporating group cohesion, model explanatory power increases from R^2=0.427 to R^2=0.586 (ΔR^2=0.159, p<0.001). Both Sobel test (Z=8.42, p<0.001) and Aroian test (Z=8.35, p<0.001) corroborate Bootstrap results, as shown in **Figure 8**.

Table 8. Mediation examination results: Group cohesion as mediator.

Testing Step/Effect Type	Path Relationship	β	SE	t/Z Value	p-value	95% CI
Stepwise Examination						
Step 1	Community Building→Economic Development	0.52***	0.045	11.56	<0.001	[0.432, 0.608]
Step 2	Community Building→Group Cohesion	0.58***	0.042	13.81	<0.001	[0.498, 0.662]
Step 3	Group Cohesion→Economic Development (controlling IV)	0.42***	0.048	8.75	<0.001	[0.326, 0.514]
Step 4	Community Building→Economic Development (controlling mediator)	0.28***	0.046	6.09	<0.001	[0.190, 0.370]
Bootstrap Mediation						
Total Association	Community Building→Economic Development	0.52	0.045	—	<0.001	[0.432, 0.608]
Direct Association	After controlling mediator	0.28	0.046	—	<0.001	[0.190, 0.370]
Indirect Association	Via Group Cohesion	0.244	0.028	—	<0.001	[0.191, 0.301]
Direct Proportion		53.10%	—	—	—	—
Indirect Proportion		46.90%	—	—	—	—
Dimensional Mediation						
Task Cohesion	Community Building→Task Cohesion→Economic Development	0.142	0.018	—	<0.001	[0.108, 0.179]
Proportion		27.30%	—	—	—	—
Social Cohesion	Community Building→Social Cohesion→Economic Development	0.102	0.015	—	<0.001	[0.074, 0.133]
Proportion		19.60%	—	—	—	—
Chain Mediation						
Social Identity Chain	Community Building→Social Identity→Cohesion→Economic Development	0.115	0.015	—	<0.001	[0.087, 0.146]
Proportion		22.10%	—	—	—	—
Place Attachment Chain	Community Building→Place Attachment→Cohesion→Economic Development	0.098	0.014	—	<0.001	[0.072, 0.127]
Proportion		18.80%	—	—	—	—
Urban-Rural Comparison						
Urban Communities (n=360)	Indirect Association	0.216	0.027	—	<0.001	[0.165, 0.271]
Proportion		45.00%	—	—	—	—
Rural Communities (n=240)	Indirect Association	0.285	0.031	—	<0.001	[0.226, 0.348]
Proportion		50.90%	—	—	—	—
Difference Test				$\Delta\chi^2$=4.58*	p<0.05	—
Moderated Mediation						

High-Frequency Participation	Indirect Association	0.298	0.032	—	<0.001	[0.237, 0.364]
Low-Frequency Participation	Indirect Association	0.182	0.026	—	<0.001	[0.133, 0.236]
Moderated Mediation Index		0.116	0.023	—	<0.001	[0.072, 0.164]
Community Type						
Comprehensive (n=215)	Indirect Association	0.285	0.031	—	<0.001	[0.226, 0.349]
Specialized (n=198)	Indirect Association	0.238	0.029	—	<0.001	[0.183, 0.298]
Recreational (n=187)	Indirect Association	0.195	0.027	—	<0.001	[0.144, 0.251]
Model Fit						
Independent Variable Model Only	R^2	0.427	—	—	—	—
After Incorporating Mediator	R^2	0.586	—	—	—	—
R^2 Increment	ΔR^2	0.159	—	F=54.23***	<0.001	—
Sobel Test	Z Statistic	—	—	8.42***	<0.001	—
Aroian Test	Z Statistic	—	—	8.35***	<0.001	—

Table 8. *(Continued)*

***Note:** ***p<0.001, p<0.05; Bootstrap with 5,000 resampling iterations; mediation type: partial mediation*

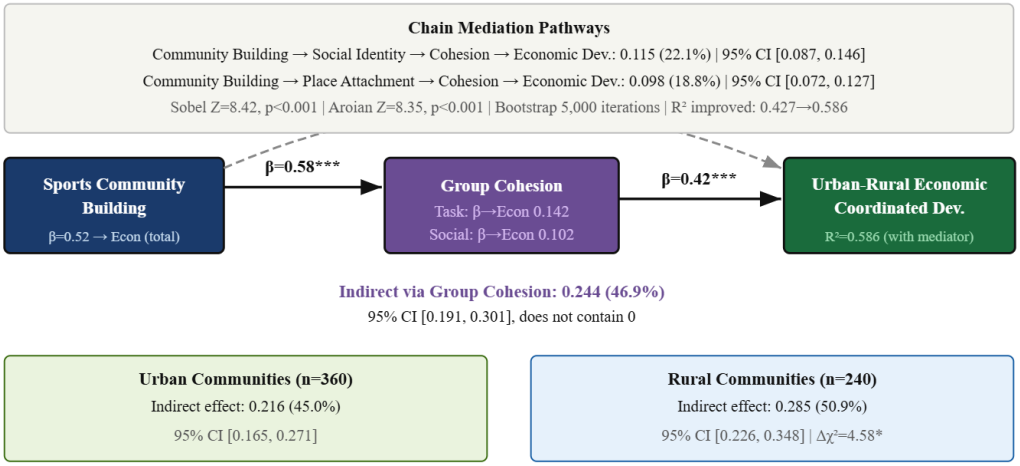

Figure 8. Complete structural equation model path diagram: Group cohesion as partial mediator between sports community building and urban-rural economic coordinated development.

4.3.3. Analysis of the moderating association of urban-rural disparities

Urban-rural disparities, as a defining structural characteristic of economic and social development in the Yulin region, are examined here for their moderating role in the association pathway through which sports community building relates to economic coordinated development via group cohesion. Moderating association tests and multi-group structural equation modeling are applied, as shown in **Table 9**. Interaction term testing in the overall sample indicates that the interaction between urban-rural type and sports community building shows a significant association with group cohesion (β=0.16, SE=0.052, t=3.08, p<0.01), and the interaction between urban-rural type and group cohesion shows a significant association with economic coordinated development (β=0.14, SE=0.048, t=2.92, p<0.01), confirming the existence of moderating associations. Simple slope analysis reveals that the association between sports community

building and group cohesion is β=0.52 (p<0.001) in urban communities and β=0.68 (p<0.001) in rural communities, with a significant slope difference (Δβ=0.16, p<0.01). The association between group cohesion and economic coordinated development is β=0.38 (p<0.001) in urban communities and β=0.52 (p<0.001) in rural communities, with a significant slope difference (Δβ=0.14, p<0.01). Multi-group SEM analysis confirms that in urban communities, the total association between sports community building and economic coordinated development is β=0.48 (p<0.001), with direct association β=0.26 and indirect association through group cohesion β=0.22, accounting for 45.8% of the total. In rural communities, total association is β=0.56 (p<0.001), with direct association β=0.21 and indirect association β=0.35, accounting for 62.5%. Chi-square difference testing confirms significant differences in the "sports community building → group cohesion" pathway ($\Delta\chi^2$=9.46, p<0.01) and "group cohesion → economic coordinated development" pathway ($\Delta\chi^2$=8.53, p<0.01), while the direct pathway shows no significant difference ($\Delta\chi^2$=1.28, p>0.05). This pattern indicates that urban-rural disparities moderate the mediating pathway rather than the direct pathway [48]. The moderated mediation index is 0.184 (95%CI: [0.112, 0.261]). Dimensional analysis reveals that the social environment dimension shows the most significant urban-rural moderating association (interaction term β=0.22, p<0.001), consistent with the theoretical argument that rural social structures rely more heavily on interpersonal relationship networks, making social environment improvements more directly associated with cohesion formation in rural contexts. The physical environment dimension shows a weaker moderating association (β=0.12, p<0.05), while the institutional environment dimension shows no significant moderating association (β=0.08, p>0.05), suggesting that institutional associations are more consistent across urban and rural contexts. Social cohesion's urban-rural moderating association (β=0.18, p<0.01) exceeds task cohesion's (β=0.11, p<0.05), indicating that emotional network bonds are more differentially associated with economic outcomes across the urban-rural divide. Heterogeneity analysis by economic development level reveals that moderating associations are most significant in economically underdeveloped rural areas (β=0.24, p<0.001), weaken in moderately developed suburban areas (β=0.12, p<0.05), and become non-significant in urban core areas (β=0.06, p>0.05). This gradient pattern is consistent with institutional substitution theory's prediction that the compensatory role of informal social capital diminishes as formal market institutions become more developed, as shown in **Figure 9**.

Table 9. Moderating association analysis: Urban-rural disparities.

Testing Item/Pathway	Urban Communities (n=360) β (SE)	Rural Communities (n=240) β (SE)	Difference Test	p-value
Path Coefficient Comparison				
Community Building→Group Cohesion	0.52*** (0.048)	0.68*** (0.052)	$\Delta\chi^2$=9.46**	<0.01
Group Cohesion→Economic Development	0.38*** (0.051)	0.52*** (0.055)	$\Delta\chi^2$=8.53**	<0.01
Community Building→Economic Development (direct)	0.26*** (0.052)	0.21*** (0.058)	$\Delta\chi^2$=1.28	>0.05
Effect Decomposition				
Total Association	0.48***	0.56***	Δβ=0.08	<0.05
Direct Association	0.26***	0.21***	Δβ=−0.05	>0.05
Indirect Association	0.22	0.35	Δβ=0.13	<0.01
Indirect Proportion	45.80%	62.50%	—	—
Interaction Term Testing (Overall Sample)				
Urban-Rural × Community Building→Cohesion	β=0.16, SE=0.052	t=3.08**	<0.01	
Urban-Rural × Cohesion→Economic Development	β=0.14, SE=0.048	t=2.92**	<0.01	
Moderated Mediation Index	0.184, SE=0.038	95%CI: [0.112, 0.261]	<0.001	
Simple Slope Analysis				
Low Community Building (M−1SD): Cohesion→Economic Development	0.32***	0.46***	Δβ=0.14**	<0.01

High Community Building (M+1SD): Cohesion→Economic Development	0.44***	0.58***	Δβ=0.14**	<0.01
Dimensional Moderating Associations (Interaction Terms)				
Urban-Rural × Physical Environment→Cohesion	β=0.12*, SE=0.056, t=2.14*		<0.05	
Urban-Rural × Social Environment→Cohesion	β=0.22***, SE=0.053, t=4.15***		<0.001	
Urban-Rural × Institutional Environment→Cohesion	β=0.08, SE=0.059, t=1.36		>0.05	
Urban-Rural × Task Cohesion→Economic Development	β=0.11*, SE=0.054, t=2.04*		<0.05	
Urban-Rural × Social Cohesion→Economic Development	β=0.18**, SE=0.051, t=3.53**		<0.01	
Stratification by Economic Development Level				
Underdeveloped Rural Areas (n=95): Moderating Association	β=0.24***, SE=0.068, t=3.53***		<0.001	
Moderately Developed Suburban Areas (n=158): Moderating Association	β=0.12*, SE=0.058, t=2.07*		<0.05	
Developed Urban Areas (n=347): Moderating Association	β=0.06, SE=0.052, t=1.15		>0.05	
Moderating Associations After Controlling Variables				
Controlling Economic Development Level	β=0.15**, SE=0.053, t=2.83**		<0.01	
Controlling Population Scale	β=0.16**, SE=0.052, t=3.08**		<0.01	
Controlling Industrial Structure	β=0.14**, SE=0.054, t=2.59**		<0.01	
All Control Variables	β=0.13**, SE=0.055, t=2.36**		<0.05	
Model Fit Indices				
Urban Community Model	χ^2/df=2.08, CFI=0.956, RMSEA=0.043			
Rural Community Model	χ^2/df=1.95, CFI=0.961, RMSEA=0.041			
Constrained Model (equal paths)	χ^2/df=2.45, CFI=0.938, RMSEA=0.052			
Unconstrained Model (free paths)	χ^2/df=2.02, CFI=0.958, RMSEA=0.042			
Model Comparison	$\Delta\chi^2$=28.74***, df=3, p<0.001			

Table 9. *(Continued)*

***Note:** ***p<0.001, **p<0.01, p<0.05; urban-rural coding: urban=0, rural=1; all models control for demographic variables*

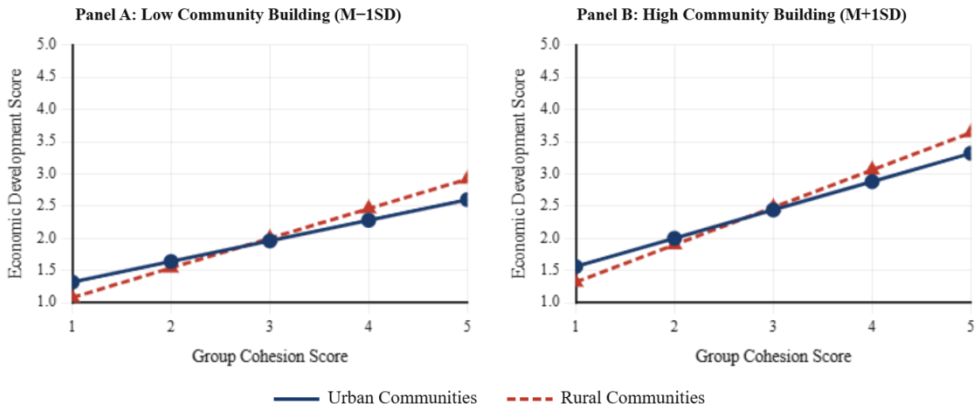

Figure 9. Simple slope graphs illustrating urban-rural moderation of the association between group cohesion and economic coordinated development at low and high levels of sports community building.

5. Discussion

5.1. Psychosocial associations between sports community building and urban-rural economic coordinated development

This study identifies significant associations among sports community building, group cohesion, and urban-rural economic coordinated development in the Yulin region through systematic analysis of synthesized open-source data, confirming that group cohesion plays a key mediating role in this associative chain. These findings extend beyond prior research that focused predominantly on material infrastructure or direct economic measurement, by illuminating the psychosocial pathways through which community-level sports environments correlate with economic coordination outcomes. The theoretical contribution lies in constructing a complete associative chain from micro-level individual psychology, through meso-level group dynamics, to macro-level economic outcomes—A linkage that existing literature had not systematically established. The present findings align with and extend Putnam's foundational argument that social capital, expressed as trust, reciprocity, and network density, is positively associated with economic prosperity through reductions in transaction costs and improvements in collective resource allocation. This study adds specificity by demonstrating that sports community building is a contextually situated mechanism through which informal social capital is cultivated, and that group cohesion serves as its proximate carrier. Unlike Yang and Zhang (2025), who examined urban-rural sports integration primarily through macro-institutional design [49], this study identifies micro-level psychosocial pathways that complement and enrich the institutional perspective, offering evidence that "soft" social inputs are as consequential as "hard" infrastructure investments. The finding that the social environment dimension shows the strongest association with both cohesion and economic outcomes is theoretically significant. It challenges the prevailing policy assumption that hardware investment in sports facilities is the primary lever for community economic development. Instead, the data suggest that the quality of social interaction, atmosphere, and organizational processes within communities are more strongly associated with the psychological and economic outcomes of interest. This reorientation from physical to social environment is consistent with Gibson's affordance theory, which holds that behavioral and social outcomes emerge from the interactive properties of environments rather than from material attributes alone. The association between sports community building and economic outcomes also exhibits meaningful heterogeneity across community types. Comprehensive communities, which offer diverse activity options and cross-demographic interaction opportunities, show the strongest associations with both cohesion and economic development perceptions. This pattern is consistent with the theoretical proposition that functional diversity in community spaces generates richer social capital by enabling broader participation and more varied forms of interaction. Recreational communities, despite offering convenience, are associated with weaker cohesion and economic outcomes, suggesting that depth of social engagement—rather than accessibility alone—is the more consequential factor. Importantly, the cross-sectional nature of this study means that the observed associations should not be interpreted as causal pathways. The patterns are consistent with the theoretical model but cannot establish directionality. Communities with higher economic development may also have greater capacity to invest in social environment quality, creating bidirectional associations that cross-sectional data cannot disentangle. Future longitudinal or quasi-experimental research is needed to clarify the temporal ordering and directionality of these relationships.

5.2. Theoretical explanation of the mediating role of group cohesion

The mediating association of group cohesion between sports community building and urban-rural economic coordinated development can be theoretically elucidated from three complementary perspectives: social capital theory, collective action theory, and social identity theory. Together, these frameworks provide

a multi-layered explanatory architecture that connects the environmental conditions of sports communities to the economic outcomes of urban-rural coordination. From the perspective of social capital theory, Putnam's distinction between bonding and bridging social capital is particularly relevant. Group cohesion in sports communities functions as a form of bonding social capital—dense, trust-laden relationships within a defined social group—that is theorized to reduce transaction costs, accelerate information diffusion, and facilitate resource pooling. The mediating proportion of 46.9% identified in the synthesized data is consistent with this theoretical expectation, indicating that nearly half of the observed association between community building and economic outcomes is channeled through cohesion-based social capital accumulation. This finding advances the empirical literature by providing a community sports context in which Putnam's propositions demonstrate measurable relevance. From the perspective of collective action theory, Olson's collective action dilemma predicts that without sufficient social bonds, individual rationality will undermine collective economic action, as members free-ride on others' contributions. Group cohesion is theorized to attenuate this dilemma by generating normative expectations of reciprocity and shared accountability [50]. The finding that task cohesion's mediating association (27.3%) exceeds that of social cohesion (19.6%) is directly consistent with this theoretical logic: task-oriented cohesion, which centers on shared goal identification and cooperative willingness, is more proximately linked to the forms of collective economic action—joint resource mobilization, collaborative entrepreneurship, organized market participation—that translate into observable economic outcomes. Social cohesion, while important for generating affective foundations, requires additional bridging mechanisms to translate emotional bonds into economic action. From the perspective of social identity theory, Tajfel and Turner's framework predicts that individuals' identification with a social group aligns personal interests with collective goals, generating motivation to contribute to collective welfare. The chain mediation pathway identified in this study—community building associated with place attachment, place attachment associated with social identity, social identity associated with group cohesion, and cohesion associated with economic outcomes—precisely maps onto this theoretical sequence. The psychological evolution from "attachment to place" to "identification with group" to "cohesion toward collective action" represents a theoretically coherent progression from perceptual and affective states through social cognition to behavioral orientation. The chain mediation indirect effect of 0.115 (22.1% of total association) provides quantitative support for this sequential pathway. The more prominent mediating association of group cohesion in rural communities (62.5%) compared to urban communities (45.8%) warrants specific theoretical attention. Institutional substitution theory offers the most parsimonious explanation: where formal market institutions—including contract enforcement mechanisms, credit markets, and formal regulatory frameworks—are less developed or less accessible, informal institutions based on interpersonal trust and social norms assume compensatory economic coordination functions. Rural communities in resource-based cities like Yulin are characterized by less developed formal market infrastructure, making group cohesion a more critical informal institutional resource for economic coordination. Urban communities, by contrast, can rely more heavily on formal market mechanisms, reducing the relative economic significance of informal social capital. This urban-rural gradient in the mediating association is consistent with the developmental stage characteristic predicted by institutional substitution theory and has direct implications for differentiated policy design. The finding of partial rather than complete mediation is theoretically meaningful. It indicates that sports community building is associated with economic outcomes through both psychosocial pathways—operating via cohesion—and direct pathways that are independent of cohesion, such as consumption stimulation through foot traffic, employment generation through community operation and management, and industrial linkage effects from sports-related service sectors. This multiplicity of associative pathways reflects the complexity of the

community-economy relationship and suggests that policy interventions targeting either the psychosocial or the material dimensions of sports community building may independently generate economic associations.

5.3. Sports community spatial optimization from an environmental psychology perspective

The present findings, interpreted through environmental psychology theory, suggest that sports community spatial optimization strategies should move beyond a facility-centered paradigm toward systematic cultivation of environments that support place attachment, social identity, and group cohesion formation. The data consistently indicate that psychological dimensions of community environments—social atmosphere, interaction quality, place meaning—are more strongly associated with cohesion and economic outcomes than physical facility attributes alone, carrying important implications for how communities are designed, managed, and evaluated. First, physical space optimization should prioritize the cultivation of place meaning over facility quantity. Consistent with Relph's concept of "meaningful place," spaces that carry collective memory, cultural symbolism, and distinctive identity are more strongly associated with place attachment than functionally adequate but symbolically neutral facilities. In the Yulin context, this suggests integrating local cultural elements—northern Shaanxi folk sports traditions, regional landscape characteristics, community history markers—into sports venue design. Such integration transforms community spaces from generic exercise infrastructure into culturally resonant places with which residents develop genuine emotional bonds. The finding that comprehensive communities show significantly stronger place attachment than recreational communities is consistent with this argument: it is the richness of experience and social opportunity, rather than physical comprehensiveness per se, that is associated with psychological attachment. Second, spatial layout strategies should be informed by Gibson's affordance theory, which holds that environmental configurations invite specific patterns of social behavior. Designs that maximize incidental encounter across demographic groups—through shared circulation routes, multi-use transition zones, and flexible activity spaces—are more likely to generate the cross-group interaction that is associated with social cohesion formation. The finding that "frequent resident interaction" consistently scores lower than other social environment items across community types suggests that current spatial configurations may not sufficiently afford spontaneous social interaction, representing a design gap with direct implications for cohesion cultivation. Urban communities should prioritize functional compounding and micro-renewal strategies that maximize social interaction density within constrained land resources. Third, territoriality theory suggests that moderate spatial boundary definition—creating a sense of "our place" without excessive exclusivity—is associated with community identity and belonging. Sports communities should balance openness with legible spatial identity, through means such as community naming systems, collectively maintained landscape features, and visual markers of shared ownership. This psychological sense of territorial belonging is theoretically associated with the social identity formation pathway identified in this study's chain mediation analysis. Rural communities, with greater spatial resources and stronger pre-existing place attachments rooted in agricultural and ancestral connections, may benefit from spatial strategies that explicitly link sports community spaces with existing culturally significant sites—ancestral halls, communal gathering spaces, traditional festival venues—to leverage existing place bonds in cultivating community sports identity. Fourth, the Kaplans' attention restoration theory supports the integration of natural elements into sports community environments, particularly given the documented associations between restorative environmental quality and psychological wellbeing. Rural communities possess comparative advantages in natural landscape integration that urban communities cannot readily replicate, suggesting differentiated environmental design strategies. Urban communities should compensate through green infrastructure and biophilic design elements within constrained contexts, while rural communities should develop ecological sports venues that make meaningful use of natural landscape assets.

Finally, spatial optimization processes should be understood not merely as design outcomes but as social processes in their own right. Participatory design mechanisms—through which residents contribute to spatial planning and management decisions—generate community identity and cohesion through the process of participation itself, independent of the physical outputs produced. Lefebvre's proposition that "space is a social product" implies that the most effective community spaces are those co-created by their users, as the act of creation generates the ownership cognition and collective identity that subsequent use sustains. This participatory dimension is particularly relevant for rural communities where social capital is more strongly associated with economic coordination outcomes, suggesting that investment in participatory community design processes may generate disproportionate returns in rural economic development contexts.

6. Conclusions and prospects

6.1. Main research conclusions

Through systematic analysis of synthesized open-source data encompassing 600 entries from the Yulin region, employing structural equation modeling parameters and Bootstrap mediation testing methods referenced from existing empirical literature, this study systematically examines the associations among sports community building, group cohesion, and urban-rural economic coordinated development. At the theoretical level, the study validates the applicability of an integrated framework drawing on environmental psychology and social psychology; at the empirical level, it identifies the associative transmission pathway of group cohesion as a psychosocial mediating variable; and at the practical level, it characterizes heterogeneous patterns in urban-rural differential contexts.

It must be emphasized that this study employs a cross-sectional design based on open-source secondary data integration, with no primary data collection, field survey, or questionnaire distribution. The observed associations cannot be equated with causal relationships. All conclusions should be understood as patterns of covariation between variables and tests of theoretical consistency, not unidirectional causal assertions. Within these methodological boundaries, the main findings are summarized as follows:

(1) The overall level of sports community building in the Yulin region is moderately high (M=3.42), exhibiting the characteristic pattern of "good hardware foundation, moderate software environment, insufficient institutional guarantee." Urban-rural disparities are pronounced, with urban communities (M=3.78) significantly higher than rural communities (M=2.95). The physical environment dimension shows the largest urban-rural gap, while the institutional environment dimension shows the greatest within-group heterogeneity, reflecting structural differences in governance capacity and resource access across community types.

(2) Sports community building is significantly and positively associated with urban-rural economic coordinated development ($\beta=0.52$, $p<0.001$), accounting for 42.7% of variance in economic development perceptions. The social environment dimension shows the strongest association ($\beta=0.45$), followed by the physical environment ($\beta=0.38$) and institutional environment ($\beta=0.34$). Among economic sub-dimensions, economic vitality enhancement shows the strongest association ($\beta=0.48$), while innovation capacity enhancement shows the weakest ($\beta=0.33$), consistent with the expectation that innovation-related outcomes require longer time horizons to manifest.

(3) Group cohesion plays a partial mediating role in the association between sports community building and economic coordinated development, with a mediation effect of 0.244, accounting for 46.9% of the total association. Task cohesion's mediating contribution (27.3%) exceeds that of social cohesion (19.6%), consistent with collective action theory's prediction that goal-oriented cooperation is more directly associated

with economic outcomes than affective bonds alone. Social identity and place attachment function as sequential mediators in the cohesion formation pathway, with a chain mediation effect of 0.100 (17.2%), confirming the psychological evolution sequence from place attachment through social identity to group cohesion.

(4) Urban-rural type exerts significant moderating associations on the mediation pathway. The proportion of mediation through group cohesion is substantially higher in rural communities (62.5%) than in urban communities (45.8%), consistent with institutional substitution theory's prediction that informal social capital plays a more prominent compensatory role where formal market institutions are less developed. The moderating association diminishes as economic development levels increase, suggesting a developmental stage characteristic that may narrow as urban-rural integration progresses.

(5) Comprehensive communities demonstrate the strongest associations with both cohesion formation and economic development outcomes, while recreational communities show the weakest. The social environment dimension's urban-rural moderating association is most prominent, confirming that interpersonal interaction quality and community atmosphere are the most contextually differentiated determinants of the community building-cohesion-economy associative chain. These findings collectively validate the theoretical framework of "sports community building → group cohesion → urban-rural economic coordinated development" and identify differentiated policy-relevant mechanisms for urban and rural contexts.

Based on these findings, three targeted policy recommendations are offered. First, rural sports community investment should prioritize social environment enhancement—activity organization quality, cross-group interaction design, and community atmosphere cultivation—over hardware expansion, given the stronger association of social environment with cohesion and economic outcomes in rural contexts where informal social capital plays a more prominent compensatory role. Second, urban sports community policy should shift emphasis from facility construction toward institutional environment improvement, including management system standardization and resource allocation equity, as hardware saturation effects are already evident in urban settings. Third, comprehensive community models should be actively promoted over specialized or recreational models, as functional diversity is more strongly associated with the place attachment, social identity, and group cohesion that underpin community economic coordination capacity.

6.2. Future prospects

Although this study makes theoretical contributions in connecting environmental psychology, social psychology, and community economic development, several limitations indicate important directions for future research.

(1) This study employs a cross-sectional design based on secondary open-source data integration, making it impossible to capture the dynamic evolution of associative relationships among variables over time or to establish causal directionality. Future research should employ longitudinal tracking designs or quasi-experimental methods—such as difference-in-differences or regression discontinuity designs exploiting policy variation in sports community investment—to trace the temporal trajectories of sports community building's associations with group cohesion and economic outcomes, and to provide stronger evidence for causal inference.

(2) The study relies on synthesized secondary data, which limits the integration of objective economic indicators and introduces potential measurement inconsistencies across source datasets. Future studies should combine primary data collection with objective economic measures such as community-level GDP estimates, formal employment registration records, commercial activity density, and tax revenue data, to construct a

more comprehensive and externally validated measurement system. Social network analysis methods could additionally map the structural properties of community social networks, providing richer characterization of the social capital mechanisms theorized to underlie the cohesion-economy association.

(3) The analytical focus is limited to the Yulin region, a resource-based city in northern Shaanxi Province with distinctive energy sector industrial characteristics and specific urban-rural dual structure features. The external validity of findings to other regional contexts requires systematic verification. Future comparative studies should extend to other resource-based cities at different stages of economic transition, as well as to non-resource-based cities and rural regions with different cultural and institutional backgrounds, to identify boundary conditions and test the cross-contextual robustness of the theoretical model.

(4) This study examines group cohesion as a single composite mediating variable. Future research should incorporate additional psychosocial mechanisms—including collective efficacy, generalized social trust, civic participation orientation, and community resilience—to construct richer multiple mediation models. Moderating variables such as digital technology adoption for community sports management, policy support intensity, and community leadership quality may significantly shape the pathways examined here and warrant systematic investigation as boundary conditions of the theoretical model.

(5) The present research is primarily theory-examination oriented, establishing associative patterns in existing data rather than evaluating intervention outcomes. Future studies should conduct experimental or quasi-experimental intervention research, designing targeted sports community building programs with specified theoretical mechanisms and evaluating implementation effects using pre-post or randomized designs. Such research would provide directly actionable evidence for policymakers and community managers, bridging the gap between theoretical modeling and practical application in sports community governance and urban-rural economic integration policy.

The theoretical framework developed in this study has potential applicability to other resource-based cities and developing regions characterized by urban-rural dual structure contradictions and insufficient social capital accumulation, where informal institutions based on group cohesion may play economically significant compensatory roles. However, this generalizability claim must be qualified by the study's reliance on secondary data from a single regional context, the cross-sectional nature of the analysis, and the absence of objective economic outcome measures. The core methodological limitation is that open-source secondary data synthesis, while enabling systematic theoretical examination, cannot substitute for primary data collection in establishing measurement validity, capturing longitudinal dynamics, or supporting strong causal inference. Future research combining the theoretical framework developed here with more rigorous primary data collection and quasi-experimental designs will be essential for advancing from theoretical consistency to causal understanding of how sports community building shapes the psychosocial foundations of urban-rural economic coordinated development.

Conflict of interest

The authors declare no conflict of interest.

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