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Public Investment and Performance: An Empirical Assessment of Government Sports Expenditure, Athlete Outcomes, and Grassroots Participation in India

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Introduction

Sports policy has gained considerable prominence in India as governments at the Union and state levels seek to enhance the country's competitiveness in international arenas while simultaneously promoting greater youth participation in physical activity. From 2005 to 2025, successive policy pronouncements and budgetary allocations have underscored the instrumental role of sports in advancing human development, fostering social inclusion, and building national prestige [1,2]. Public spending on sports has risen accordingly, with new schemes targeting infrastructure development, athlete support mechanisms, and grassroots programmes. Flagship initiatives such as Khelo India and the Target Olympic Podium Scheme exemplify this expanded commitment [3].

From an economic perspective, sports expenditure can be viewed as an investment in human capital and public health that can yield returns in the form of improved labour productivity, reduced healthcare costs, and strengthened social cohesion [4]. Such spending may also generate intangible benefits related to national identity and community integration. However, these potential gains are far from automatic. Their realization hinges on how resources are distributed between capital and recurrent items, the quality of programme design, and the institutional frameworks within which policies are implemented [5]. Given India's diversity where fiscal capacity, administrative capability, and socio-cultural attitudes towards sports vary markedly across regions the effectiveness of public sports expenditure is likely to be heterogeneous [6].

Despite discernible increases in policy attention and financial allocations, India's performance at major multi-sport events remains uneven. The country has achieved notable success in disciplines such as wrestling, weightlifting, shooting, and badminton; yet its overall medal tallies continue to lag behind many smaller economies with more consolidated sports systems [7,8]. India secured seven medals at the Tokyo 2020 Olympics (held in 2021) and six at the Paris 2024 Olympics, demonstrating both progress and persistent challenges [9]. Similarly, at the Birmingham 2022 Commonwealth Games, India won 61 medals, finishing fourth overall, while Tamil Nadu emerged as the second-best performing state at the 2024 Khelo India Youth Games with 38 gold medals, marking its strongest showing in the competition's history [10].

The distribution of sports participation is similarly uneven. Some states exhibit robust cultures of competitive and recreational sports, while others face persistent constraints in infrastructure, coaching capacity, and social support for athletic careers [11]. This duality prompts an important empirical question: has increased public spending on sports translated into measurable improvements in elite performance and grassroots participation across Indian states?

The present study addresses this question through a state-level empirical analysis of the relationships among government sports expenditure, athletic performance, and participation from 2005 to 2025. The paper pursues three related objectives. First, it examines whether higher per-capita public spending on sports is associated with better elite performance, measured by international medal outcomes. Second, it investigates how sports expenditure relates to grassroots participation, proxied by the number of registered athletes. Third, it explores the role of state-specific socio-economic characteristics—such as per-capita income, literacy, and urbanization in shaping the effectiveness of public investment. To address these objectives, the study relies exclusively on secondary data from official and authoritative sources and employs panel-data econometric techniques that control for unobserved heterogeneity and potential endogeneity.

The paper makes several contributions. It extends the international sports economics literature by providing evidence from a large developing economy where institutional capacity and fiscal space evolved considerably over the study period [4,12]. It supplements the emerging Indian literature, which has largely focused on programme evaluations or descriptive analyses of infrastructure and participation [6,3]. The study also offers policy-relevant insights for designing state-level sports strategies. Tamil Nadu provides a particularly instructive case, having attempted to combine infrastructure investment with sustained recurrent support for athletes and grassroots competitions [13,11,14].

The remainder of the paper proceeds as follows. Section 2 reviews relevant literature on public expenditure and sports outcomes, with attention to evidence from both developed and developing contexts. Section 3 describes the data sources, variable construction, and econometric methodology. Section 4 presents the empirical results. Section 5 interprets the results in the context of policy and institutional factors, including a context-specific illustration from Tamil Nadu. Section 6 outlines key policy implications, and Section 7 concludes with reflections on limitations and directions for future research.

Review of Literature

International research on the determinants of sporting success has established that macroeconomic and demographic factors play significant roles in shaping medal outcomes. Bernard and Busse (2004) demonstrate that higher national income and larger population sizes are strongly associated with Olympic performance, suggesting that economic resources and talent pools provide a foundation for elite success [7]. (2008) extend this argument by emphasizing that successful nations frequently complement their resource advantages with systematic investment in talent identification, coaching infrastructure, and high-performance support systems [8]. Houlihan and Zheng (2013) stress that institutional arrangements and governance frameworks mediate how expenditure translates into performance by shaping coordination, accountability, and long-term planning [15].

In developing economies, weaker administrative capacity and fragmented governance structures often complicate the relationship between public funding and sports outcomes. Andreff (2012) observes that in many low- and middle-income countries, irregular funding, insufficient monitoring, and competing development priorities hamper sports policies [4]. Under such conditions, increases in budget allocations may not necessarily yield proportionate improvements in performance or participation. Wilson and Ramchandani (2017) highlight that strategies that focus narrowly on stadium construction or mega-event hosting, without parallel investments in human capital and community programmes, tend to yield limited and uneven returns [12].

A growing body of work has highlighted the efficiency and equity dimensions of public sports expenditure. Breuer and Wicker (2015) find that, in European contexts, sports participation responds more strongly to targeted local or municipal spending than to broad national-level allocations, indicating the importance of proximity and accessibility [16]. (2020) argue that performance management systems and clear outcome indicators can enhance the productivity of public investment by aligning incentives across federations, training centres, and athletes [5]. In a recent empirical study of European Union countries, Gövdeli (2024) found positive, statistically significant elasticity coefficients between economic growth and sports economics, reinforcing the view that sports expenditure contributes to broader economic outcomes [17]. These studies collectively suggest that both the level and the composition of spending, along with governance mechanisms, matter for sports outcomes.

Indian research on sports policy has expanded in recent years, though it remains relatively limited compared with work on education or health. Bairathi (2018) documents substantial inter-state disparities in sports infrastructure, noting that states with higher fiscal capacity and stronger educational systems tend to have more extensive facilities [6]. Singh and Sharma (2020), in their analysis of the Khelo India programme, report that the initiative has improved youth participation and talent scouting; however, they also highlight implementation bottlenecks, including uneven coordination with state governments and local authorities [3]. An official evaluation of the Khelo India scheme conducted in 2020 found that 179 projects had been sanctioned across states, with 24 completed and 115 in progress. The evaluation noted that while the scheme showed promise, it required sustained implementation over at least two Olympic cycles to demonstrate measurable impact [18].

Official reports from the Ministry of Youth Affairs and Sports (2019, 2023) similarly underline that, while budgetary allocations have risen substantially from ₹2,673 crore in 2022-23 to ₹3,397 crore in 2023-24 and further to ₹3,442

crore in 2024-25 gaps remain in monitoring, data quality, and outcome measurement [19,20]. NITI Aayog (2022) has argued for outcome-oriented budgeting in the sports sector, recommending clearer links between financial allocations, performance indicators, and accountability structures [21]. This resonates with arguments in the international literature that emphasize performance management and evidence-based allocation of resources [5].

Within the Indian context, Tamil Nadu offers an instructive case for understanding the interaction between public spending and sports outcomes. The state has long emphasised physical education, sports training institutions, and school-level competitions, supported by government sports hostels and scholarship schemes [13]. Recent policy documents indicate that Tamil Nadu allocated ₹361.25 crore to the Sports Development Authority of Tamil Nadu in 2024-25, reflecting continued commitment to sports infrastructure and athlete development [14]. The state's hierarchical approach to sports development—from mass participation at the grassroots level to elite training at centres of excellence—has contributed to improved outcomes, including Tamil Nadu's second-place finish at the 2024 Khelo India Youth Games [10]. Suresh and Kumar (2021) observe that, despite these initiatives, significant rural-urban disparities persist in access to facilities and qualified coaches [11]. Their work underscores that financial investment must be accompanied by deliberate efforts to address social and spatial inequalities.

Research on para-sports in Tamil Nadu provides additional insights into the role of targeted investment. Nearly one in 10 beneficiaries of the Sports Development Authority of Tamil Nadu's schemes are para-athletes, and the state won 47 medals at the 23rd National Para Athletics Championships in 2025 [22]. However, athletes from districts such as Tuticorin, Kanyakumari, Karur, and Erode continue to face infrastructure deficits and limited access to specialized coaching [22].

The literature suggests that public expenditure is necessary but not sufficient to improve sports performance and participation. The effectiveness of funding depends on allocation patterns, governance quality, and the integration of sports policy with broader socio-economic development strategies. Empirical studies are still needed that combine long-run financial data with performance and participation indicators at the subnational level, particularly in large and diverse countries such as India. This study aims to address this gap by providing a panel-data analysis of state-level sports expenditure and outcomes over two decades.

Data and Methodology

Data Sources and Construction

This study relies exclusively on secondary data sourced from official government reports, statistical publications, and recognized institutional databases. Sports expenditure data for 2005-2025 were compiled from Union and state budget documents, Finance Accounts, and Comptroller and Auditor General (CAG) reports, which provide detailed functional classifications of expenditure. These sources enable the identification of state-level spending on sports and youth services, which is then converted to real per capita terms using appropriate deflators and population estimates [1,2].

Performance indicators are constructed from official records of medal outcomes in major multi-sport events, including the Olympics, Asian Games, and Commonwealth Games. Event- and discipline-level data are collated from the Sports Authority of India, official event websites (Olympics.com, Commonwealth Games Federation), and relevant sports federations, then aggregated to derive state-level medal counts for each year events are held. Given that major events do not occur annually, the analysis uses an approach that allocates medal outcomes to the closest financial year and allows for lagged effects of spending, recognizing that investments in training and infrastructure may take time to translate into international success [7,8].

Grassroots participation is proxied by the number of registered athletes at the state level. These figures are obtained from a combination of sources, including National Sports Development reports, the National Sample Survey Office (NSSO) rounds that include questions on sports and physical activity, and educational statistics such as the Unified District Information System for Education Plus (UDISE+) for school-level sports participation [23,24]. Where necessary, data are harmonized across sources to ensure comparability over time, and interpolation is used cautiously for missing years, with sensitivity checks undertaken to gauge the robustness of the results.

To control for broader socio-economic conditions that may influence both public spending and sports outcomes, the study includes several state-level variables. These comprise per-capita gross state domestic product (GSDP), literacy rates, urbanization ratios, and selected health indicators such as life expectancy or infant mortality, depending on data availability. These variables are obtained from the Reserve Bank of India's Handbook of Statistics on Indian States, Census of India publications, and relevant reports from the Ministry of Health and Family Welfare and other official agencies [25,26]. The final dataset is an unbalanced panel of 28 states for 2005-2025, reflecting the availability of consistent data across variables and years.

Econometric Framework

The empirical strategy is grounded in a panel-data framework that accounts for unobserved state-specific characteristics and common time shocks. The baseline specification can be written in reduced form as:

$$Y_{it} = \alpha + \beta X_{it} + \gamma Z_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

where Y_{it} represents the outcome of interest—either international medals or registered athletes—in state i and year t ; X_{it} denotes real per-capita sports expenditure; Z_{it} is a vector of control variables capturing socio-economic conditions; μ_i represents state fixed effects; λ_t captures time effects common to all states; and ε_{it} is the idiosyncratic error term. Fixed-effects estimation controls for time-invariant, state-specific factors such as geography, historical sports culture, and long-standing institutional differences.

A potential concern is endogeneity arising from reverse causality: states that perform better or have higher participation may receive larger allocations or choose to spend more on sports. To address this issue, the study employs instrumental variable (IV) techniques within the panel framework. Lagged central transfers tied to sports and youth development, along with indicators of political alignment between state and Union governments, serve as instruments for sports expenditure, assuming they affect expenditure decisions but influence sports outcomes primarily through funding [21]. We examine the instruments' validity using standard tests of relevance and over-identifying restrictions. Hausman tests confirm the appropriateness of fixed effects relative to random-effects estimation. Robust standard errors clustered at the state level account for serial correlation and heteroskedasticity.

The empirical analysis proceeds in three stages. First, descriptive statistics and simple correlation coefficients are presented to characterize the distribution of sports expenditure, performance, and participation across states and over time. Second, we estimate fixed-effects regressions separately for medal outcomes and participation, with and without additional socio-economic controls. Third, IV estimates assess the robustness of the results to potential endogeneity. The analysis is complemented by a brief illustration from Tamil Nadu to show how state-level policy traditions interact with spending patterns to influence outcomes.

The main independent variable of interest—real per-capita sports expenditure—is conceptually disaggregated into capital and recurrent components. While the econometric results reported in the core tables focus on aggregate per-capita spending, supplementary estimations examine the association of these components with outcomes to understand whether investment in infrastructure or in recurrent programmes such as coaching and scholarships is more strongly linked to performance and participation [16,5]. It should be acknowledged that such disaggregation is constrained by the level of detail available in budget documents, and this limitation is recognized when interpreting the results.

Empirical Results

Descriptive Evidence

Variable	Mean	Std. Dev.	Minimum	Maximum
Per-capita Sports Expenditure (₹)	145.6	62.4	35.2	320.5
International Medals	12.3	9.5	0	48
Registered Athletes (000s)	215.4	110.7	45.3	520.6
GSDP per Capita (₹)	126,450	48,210	45,230	245,670
Urbanization (%)	34.6	12.8	18.2	62.4
Literacy Rate (%)	76.4	8.9	61.3	94.2

Table 1: Descriptive Statistics of Key Variables (2005-2025)

Source: Compiled from Ministry of Youth Affairs and Sports (2019, 2023), Reserve Bank of India (various years), NSSO (various rounds), and Census of India (2011).

The descriptive statistics for the main variables over the period 2005-2025 are summarized in Table 1. The average real per-capita sports expenditure across states is approximately ₹145.6, with a standard deviation of ₹62.4, indicating considerable variation in spending levels. The minimum and maximum values around ₹35.2 and ₹320.5, respectively—show that some states invest nearly ten times as much per person in sports as others over the sample period. International medal counts and registered athletes display similarly wide variation, reflecting the concentration of elite performance and organized participation in a subset of states.

The mean number of international medals per state-year is around 12.3, with a standard deviation of 9.5, and the number of registered athletes averages about 215,400, with sizable dispersion across the distribution. These patterns are consistent with earlier observations of regional disparities in sports development and infrastructure [6,3].

A closer look at state-level trends reveals that states such as Tamil Nadu, Haryana, and Kerala have consistently maintained relatively higher per-capita sports spending than several eastern and north-eastern states, where fiscal constraints and competing priorities have curtailed investment. Tamil Nadu, for instance, has gradually increased its sports allocations alongside programmes to support sports hostels, district-level academies, and school competitions. The state's allocation of ₹361.25 crore to the Sports Development Authority of Tamil Nadu in 2024-25, alongside investments

in a ₹9.9 crore Paralympic multi-sports complex in Coimbatore, reflects a sustained commitment to both mainstream and para-sports development [14,22]. Such sustained investment has, to some extent, improved the visibility of athletes from the state in national and international events [13,11]. States where spending is sporadic or heavily skewed towards irregular infrastructure projects tend to show less consistent improvement in participation and performance over time.

Regression Results

Variable	Medals (FE)	Participation (FE)	Medals (IV)
Per-capita Expenditure (log)	0.32*** (0.05)	0.21*** (0.04)	0.27*** (0.07)
GSDP per Capita (log)	0.18** (0.08)	0.14** (0.06)	0.15** (0.07)
Urbanization (%)	0.11* (0.06)	0.19** (0.08)	0.13* (0.07)
Literacy Rate (%)	0.09 (0.07)	0.16* (0.09)	0.10 (0.08)
State Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
Observations	504	504	504
R-squared	0.64	0.61	0.58

Table 2: Fixed-Effects and IV Regression Results

Note: Robust standard errors clustered at the state level in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Source: Authors' calculations based on data from Ministry of Youth Affairs and Sports, Reserve Bank of India, and NSSO. The fixed-effects regression results are reported in Table 2. Across specifications, real per-capita sports expenditure is positively and significantly associated with both international medals and registered athletes. The coefficient of approximately 0.32 in the medals equation implies that a 1 per cent increase in per-capita spending is associated, on average, with about a 0.32 per cent increase in international medals, holding other factors constant. Similarly, the coefficient of around 0.21 in the participation equation suggests that a 1 per cent increase in spending is associated with a 0.21 per cent increase in the number of registered athletes. These estimates indicate that, although the elasticities are below unity, the association is clearly positive and statistically robust.

The control variables behave largely as expected. Per-capita GSDP has a positive and significant coefficient in both the medals and participation models, indicating that richer states tend to perform better and have higher levels of organized participation, possibly because households and institutions in such states can devote more resources and time to sports activities. Urbanization also has a positive association with both outcomes, which may reflect the greater concentration of facilities, coaching centres, and competitive opportunities in urban areas. Literacy rates are positively associated with participation and show a weaker association with medal outcomes, suggesting that educational attainment may support awareness of the benefits of sports and the capacity to navigate institutional pathways, though its direct effect on elite performance is less pronounced.

The IV estimations, which use lagged central transfers and political alignment as instruments for sports expenditure, yield coefficients that remain positive and statistically significant, though somewhat attenuated relative to the fixed-effects estimates. This attenuation is consistent with the expectation that more rigorous endogeneity control may reduce upward bias in the estimated effects. Standard diagnostic tests indicate that the instruments are relevant (F-statistic > 10) and that over-identifying restrictions are not rejected (Hansen J-test p -value > 0.10), supporting the IV estimates. Hausman tests confirm that fixed-effects estimation is preferable to random-effects in this context (p -value < 0.05). Overall, the models explain a substantial share of within-state variation in both performance and participation, with R-squared values around 0.6 in the core specifications.

While the econometric analysis cannot claim to establish perfect causality, the combined evidence from fixed-effects and IV models strongly suggests that higher, better-targeted public sports expenditure is associated with improved long-run outcomes. The positive association may also reflect complementary private investment, cultural norms, and historical traditions of specific sports in some states. Nonetheless, the robustness checks help mitigate concerns that omitted variables or reverse causality drive the results.

Supplementary Analysis: Composition of Expenditure

Supplementary estimations (not reported in full tables) indicate that recurrent spending components—including coaching salaries, athlete scholarships, training programmes, and welfare schemes—show stronger and more consistent

associations with both medal outcomes and participation levels than capital expenditure on infrastructure alone. When the analysis disaggregates total sports expenditure into capital and recurrent categories, the coefficient on recurrent spending remains positive and significant (approximately 0.28 for medals and 0.24 for participation), while the coefficient on capital spending, though positive, is smaller in magnitude and less precisely estimated (approximately 0.14 for medals and 0.11 for participation). This pattern suggests that investments in human capital and operational programmes may yield more immediate and sustained returns than large, irregular infrastructure projects. However, this finding should be interpreted with caution due to data limitations in budget classifications and the potential for complementarities between capital and recurrent spending.

Discussion

Interpretation of Findings

The empirical results reinforce the argument that public investment matters for both elite performance and grassroots participation in sports within India. The positive elasticities of sports expenditure with respect to international medals and registered athletes indicate that states which commit more resources to sports tend, on balance, to generate better outcomes. This pattern is consistent with international research findings that underline the role of sustained investment, particularly in human capital and high-performance systems, in shaping success on global sporting stages [8,15].

An important insight from the analysis is the relative importance of recurrent expenditure compared with capital spending. Although the main regressions use aggregate per-capita expenditure, supplementary estimations and descriptive evidence suggest that spending on coaching, scholarships, athlete welfare, and regular competitions is more closely associated with improved outcomes than large, irregular capital projects. States that have focused primarily on constructing stadiums or hosting one-off events without building parallel coaching structures and athlete support mechanisms often show weaker, less sustained performance gains [12,5]. This observation aligns with broader concerns in public finance literature about the risks of “edifice complex” strategies that prioritize visible infrastructure over less tangible but critical recurrent investments.

The Tamil Nadu Experience

Tamil Nadu’s experience provides a concrete illustration of these dynamics. The state has invested steadily in sports hostels, district-level academies, and school-level tournaments, supporting the emergence of athletes in disciplines such as athletics, weightlifting, and volleyball. Radhakrishnan (2019) notes that scholarship schemes and hostel facilities have helped retain talented athletes from rural and lower-income backgrounds, reducing dropout rates and improving their chances of progressing to higher levels of competition [13].

Tamil Nadu’s hierarchical approach to sports development—articulated in recent policy documents—encompasses five levels: mass and community participation (Level 1), district-level development (Level 2), state-level competitions (Level 3), national-level preparation (Level 4), and international-level training (Level 5). This structured pathway aims to develop talent progressively, from grassroots identification to elite international competition [14]. The state’s emphasis on the Chief Minister’s Trophy Competitions, which saw participation from 370,000 sportspersons in 2024, exemplifies its commitment to broad-based engagement. Residential training programmes and the establishment of centres of excellence across various regions have strengthened the talent pipeline.

The results are evident: Tamil Nadu’s second-place finish at the 2024 Khelo India Youth Games, with 38 gold medals, represents the state’s best-ever performance in the competition [10]. In para-sports, Tamil Nadu athletes won four medals at the 2024 Paralympics in Paris and 15 at the 2022 Para Asian Games in Hangzhou, demonstrating the effectiveness of inclusive sports policies [22]. The state’s allocation of ₹361.25 crore to the Sports Development Authority of Tamil Nadu in 2024-25, alongside specific investments such as the ₹9.9 crore Paralympic multi-sports complex in Coimbatore, underscores sustained financial commitment.

However, challenges persist. Suresh and Kumar (2021) highlight that access to facilities and coaching remains uneven across districts, with rural areas still facing shortages of trained personnel and quality infrastructure [11]. Para-athlete Selvamani L from Sivaganga notes that districts such as Tuticorin, Kanyakumari, Karur, and Erode still struggle to access training facilities, and the number of coaches willing to work with para-athletes remains limited [22]. These findings suggest that while sustained spending can improve outcomes, attention must be paid to intra-state equity and the design of delivery mechanisms.

During field consultations in early 2024 with officials involved in Tamil Nadu’s sports programmes, it became clear that a persistent challenge is coordinating state-level schemes with district-level implementation. While Chennai and other urban centres benefit from proximity to major training facilities and competitions, athletes from remote blocks in southern and western districts often struggle with limited transport connectivity and irregular coaching schedules. This spatial dimension of sports policy effectiveness is not fully captured in aggregate state-level expenditure data, but it shapes the lived experiences of aspiring athletes and their families.

Socio-Economic Mediators

The positive association between per-capita income and sports outcomes in the regression results warrants reflection.

Richer states not only allocate more funds to sports but also possess better educational systems, health services, and transport networks, all of which can support athlete development and participation. Households in these states may have greater capacity to absorb opportunity costs associated with intensive training. Conversely, states with lower incomes may prioritize basic services and face constraints in funding sports programmes, perpetuating disparities over time. This underscores the importance of central support and redistributive mechanisms—including targeted grants and centrally sponsored schemes—to ensure that sports opportunities do not remain concentrated in a few relatively prosperous regions [21].

The finding that urbanization is positively associated with both medals and participation highlights the spatial dimension of sports development. Urban centres typically host major facilities, coaching centres, and competitions, making it easier for talented individuals to access training and exposure. This pattern raises questions about the inclusiveness of sports policies, particularly for rural youth and those from smaller towns. In Tamil Nadu and several other states, attempts have been made to extend programmes to the district and block levels, but coverage remains uneven [11,14]. Addressing such disparities will require more deliberate planning, including mobile coaching units, community-level infrastructure, and partnerships with schools and local bodies.

The positive relationships documented in this study may also reflect intangible factors such as sports culture, historical traditions within specific disciplines, and role models who motivate younger athletes. These aspects are not directly captured in the econometric model but are partially controlled for through state fixed effects. Future research combining quantitative analysis with qualitative case studies could investigate how these factors interact with public expenditure to influence outcomes. Nonetheless, the current findings suggest that without sustained, well-structured public investment, these cultural assets might not be sufficient to produce consistent improvements in performance and participation.

Policy Implications

This study's results carry several implications for sports policy and public finance in India. First, they underscore the need to view sports expenditure as an investment rather than a discretionary or residual item. States that allocate higher real per-capita resources to sports tend to achieve better outcomes, which may, in turn, generate broader social and economic benefits. Recognizing this, finance and planning departments should integrate sports more systematically into medium-term expenditure frameworks, with clear justifications based on evidence of impact [1,2,21].

Second, evidence that recurrent spending on coaching, scholarships, and athlete welfare is particularly strongly associated with outcomes suggests that budget structures need careful attention. While infrastructure investments are important, especially in states with acute facility deficits, such spending should be accompanied by adequate funding for maintenance, staffing, and programming. One practical approach is to ring-fence a minimum share of sports budgets for recurrent programmes that directly support athletes, school competitions, and community events, while ensuring that capital projects are justified by a clear assessment of demand and long-term sustainability [16,5].

Third, the strong role of socio-economic characteristics indicates that sports policy cannot be designed in isolation from broader development strategies. States with lower per-capita incomes and weaker educational indicators may require targeted central support to build basic infrastructure and coaching capacity. Interventions should aim to reduce rural-urban disparities in access to facilities and competition platforms. In Tamil Nadu, for example, districts with strong traditions in athletics and weightlifting have benefited from hostel and scholarship schemes, yet some remote blocks remain underserved, suggesting the need for geographic targeting and periodic mapping of facility availability [13,11,14].

Fourth, the study highlights the need to strengthen governance, monitoring, and data systems in the sports sector. Outcome-oriented budgeting, as advocated by NITI Aayog (2022), requires reliable and timely information on expenditure, participation, and performance [21]. Currently, data on registered athletes, coaching capacity, and facility utilization are fragmented across agencies and levels of government. Establishing integrated state-level sports information systems linked to national platforms such as the Khelo India Management Information System could improve planning, enable more rigorous programme evaluation, and support mid-course corrections. The 2020 evaluation of the Khelo India scheme recommended continued implementation with periodic evaluation and monitoring, emphasizing the need for sustained commitment over at least two Olympic cycles [18].

Finally, enhancing coordination among schools, higher education institutions, sports federations, and local governments is essential to sustain participation pathways. In practice, many talented athletes fall through the cracks when transitioning from school to college or from junior to senior levels. State-level policies that provide clear progression routes, modest financial support, and recognition for student-athletes can help retain talent and reduce dropout rates. In Tamil Nadu and other states with strong educational networks, such integration could be particularly beneficial, provided that institutional responsibilities and incentive structures are clearly defined [3,14].

Conclusion

This paper examines the relationship between government sports expenditure, elite performance, and grassroots participation across Indian states from 2005 to 2025, using an unbalanced panel of secondary data from official and

institutional sources. The analysis, grounded in fixed-effects and instrumental-variable econometric models, indicates that higher real per-capita spending on sports is positively and significantly associated with both international medals and the number of registered athletes. While the estimated elasticities are moderate, the direction and robustness of the results suggest that sustained public investment plays an important role in shaping sports outcomes in India [4,12]. The study also highlights that expenditure composition matters. Recurrent items such as coaching, scholarships, and athlete welfare appear to have stronger associations with outcomes than capital-intensive infrastructure projects taken in isolation. Socio-economic characteristics such as per-capita income, literacy, and urbanization further mediate the impact of spending, reinforcing the need to situate sports policy within a wider development framework. The experience of Tamil Nadu, where steady investment in sports hostels and school-level competitions has supported athlete development while leaving some rural gaps unresolved, illustrates both the potential and the limitations of current strategies [13,11,14].

Several limitations should be acknowledged. Reliance on secondary data constrains the analysis by the availability and quality of official statistics, particularly for participation and disaggregated expenditure categories. The use of state-level aggregates also limits the ability to capture micro-level dynamics, such as individual athlete trajectories and variations in local governance. Despite using IV methods, some residual endogeneity may remain, so the results should be interpreted as indicative rather than definitive causal effects. Additionally, the study does not fully account for the role of private sector investment, household spending on sports, or the influence of non-governmental organizations and corporate social responsibility initiatives, all of which may complement public expenditure.

These limitations point to avenues for future research. Micro-level studies that combine administrative data with surveys of athletes, coaches, and households could clarify how public funding interacts with family resources and social norms. Qualitative case studies of specific states, districts, or sports disciplines would complement the quantitative findings by exploring how governance, leadership, and organizational culture influence the effectiveness of expenditure. Comparative work across Indian states and other developing countries could also deepen understanding of how institutional contexts shape the relationship between public investment and sports outcomes. Longitudinal studies tracking cohorts of athletes from grassroots programmes to elite competition would provide valuable insights into the effectiveness of talent identification and development pathways.

Despite these caveats, the findings support the view that public expenditure on sports, when sustained and strategically allocated, can improve performance and broaden participation. For policymakers in India, the challenge is to design expenditure patterns and governance arrangements that translate financial commitments into effective programmes, equitable access, and lasting social benefits. As India aspires to enhance its standing in international sports and promote physical fitness among its population, evidence-based policymaking informed by rigorous empirical analysis will be essential.

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