

Sports Infrastructure Development and Youth Sporting Success: Cross-State Variations in India

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ABSTRACT

This study investigates the relationship between the sports infrastructure investment made by the Khelo India program and youth sporting success across Indian states using data from the Khelo India Youth Games of 2022, 2023, and 2025. The study employs a quantitative research design using secondary data to analyse the amount of funds invested in sports infrastructure by Khelo India in each of the 28 Indian states and 8 union territories, and their medal performance. Other variables considered include the number of participants by state, the medal conversion rates, and the distance of the states from the host city, allowing for a clearer picture of the factors affecting sporting outcomes. The findings reveal a positive but moderate relationship between infrastructure funding and sporting medal performance, with funding accounting for 12.5% of the medal performance outcome. Considering the efficiency of infrastructure investments in each state, it becomes evident that some states produce remarkable results with minimal investment, while others receive significant investments yet produce poor results. Therefore, despite the importance of infrastructure investments in determining the success of youth sports, other factors, such as the quality of coaches, the sporting culture that exists in these areas, and the support given to sports by governments and institutions, are equally important. To achieve these goals, the Khelo India programme must also invest in the development of human resources within the country.

Keywords: Khelo India Youth Games, Sports infrastructure investment, Youth sporting success, Medal conversion rate, Sports participation

INTRODUCTION

India is home to one of the youngest populations in the world, with nearly 65% of the country's population under the age of 35. Despite being the home to such a young population, however, the country has historically produced modest performances in international sporting competitions. Strong performances in sports generate significant returns for the country, acting as indicators of its development and the potential it inspires in its youth to participate in sports. The nation began to address this issue in the year 2017, when the Ministry of Youth Affairs and Sports began the Khelo India programme which is the most significant centralized development towards the improvement of sports infrastructure in the nation, with the budget allocation reaching 1000 crore in 2025-26, representing around 26% of the total

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2025-26 budget by the Ministry (Press Trust of India, 2025). The ministry intended to use these funds to construct sporting infrastructure across all states and union territories, for instance, through athletic tracks, football fields, hockey turfs, swimming pools, and multipurpose sports halls. These facilities aimed to create the physical conditions that would allow for talent identification and the development of young athletes throughout India.

The Khelo India Youth Games were inaugurated in 2018 and have since been held annually throughout the country. During these competitions, athletes from across the nation compete in various sporting events, providing a comparable measure of sporting performance for each state. Despite the magnitude of this program, however, there has been limited analysis into whether the investment in such infrastructure has resulted in improvements in the performance of young athletes across states. The International Institute of Sports Management (IISM) reports that only approximately 100 sports facilities exist in the country that meet international standards. Furthermore, these government-funded facilities are mostly underutilised and poorly maintained. Given the varying accessibility of sporting opportunities across socioeconomic and geographic groups within India, it is essential to understand whether the investments into constructing sports facilities across the country have been effectively utilised to develop athletes. The answer to this question may differ from state to state, as the socio-economic context across states may differ.

This study intends to analyse whether the investments made in sporting infrastructure in individual states by Khelo India correlate with the medals earned by the athletes from those states during the Khelo India Youth Games. Specifically, the medals earned by the participating athletes during the 2022 Games in Haryana, 2023 Games in Tamil Nadu, and 2025 Games in Bihar will be analysed using Indian government data on the construction of sporting infrastructure within these states, the amount of funds sanctioned, the number of medals earned, and more. This analysis finds that infrastructure investment has a positive yet weak relationship with both medal outcomes and participation.

LITERATURE REVIEW

Previous studies have shown that the sports infrastructure within a region has a pivotal role in determining the success rates of youth athletes. Though there has been over ₹2,000 crore in sports infrastructure investment through the Khelo India initiative, the results have been uneven between the different states. However, no studies have been conducted on the topic of whether there is a positive relationship between infrastructure and the success of youth athletes across the states of India. The literature on this topic can be reviewed in two different strands: international studies regarding the effect of sports infrastructure on participation rates, and studies that relate to India and the Khelo India initiative specifically.

International Evidence

Studies from around the globe continue to reveal that nations with better infrastructure have a greater number of youths who participate in sports. Economic theory suggests that with sports requiring an

individual's time and financial contributions to participation, it is likely that those with higher time costs will participate less in sports, highlighting the integral role of access barriers in limiting participation.

A 2013 study by Wicker et al. used a multi-level modelling methodology to determine the relationship between access to sports infrastructure and participation in sports. Data from Munich, Germany, which included 11,175 survey responders and mapped the location of sports infrastructure within the municipality in 100 different zones, revealed that access to swimming pools was correlated with an increased rate of overall participation, while access to sports fields was correlated with increased participation in sports clubs. Furthermore, internal analyses of the model indicated that individual factors like time constraints, age, and motivation were correlated with the effect of infrastructure on sports participation.

A more recent study by Pandya and McCarthy (2021) investigated the various global barriers to sports participation among youth and revealed the impact of socioeconomic factors on sports. Results from the study indicated that the financial cost of youth sports was a major barrier to participation; the average cost of a sport per year was found to be prohibitive for low-income families, as the costs often exceeded \$1,500 per year. For instance, only 22% of children of low-income families participated in sports compared to 43% of children of lower-middle-income families. Furthermore, the decline in free physical education in United States schools has had a similar impact upon low-income populations due to the financial barriers of private coaching. This demonstrates that financial factors do indeed shape participation outcomes.

Separately, another research study by De Bosscher et al. (2009) investigated the relationship between sport policy systems and international sports success. The authors used the SPLISS model to determine the four pillars that are instrumental in the successes of athletes: support for the athletes, financial resources for the nation's sports programs, training centres, and the development of coaches. Based on a sample of six countries, the study found, though with inconclusive results, that the countries with the most success in international competitions combined each of these four factors.

While each of these international studies relates to factors that impact sporting success, none of them has attempted to determine the extent of the impact of infrastructure investments upon sporting success, particularly within youth populations and on a state-specific level.

Indian Context

Turning to the Indian context specifically, a report by the International Institute of Sports Management (IISM, 2024) provides the most comprehensive overview of the state of sports infrastructure within the country. This report found that only around 100 sports facilities within the nation meet international standards for sports facilities, and that most existing facilities are underutilised. Furthermore, these facilities are mostly used to host sporting competitions, rather than to provide a platform for grassroots training. Nonetheless, the Khelo India program has increased its allocation of funds to sports infrastructure from around ₹118 crore in 2016-17 to ₹520 crore in 2018-19, representing an increase from

8% to 24% of the overall sports budget of the country. Barriers to success in these programs, according to the report, include the country's complex policies, which delay the allocation of these funds, the low rates of occupancy of existing sports facilities, the lack of transparency in fund allocation to sports programs at the state-level, and the lack of land for the development of sports facilities. These barriers help explain why funding and outcomes do not correlate strongly.

A separate study by authors Parmar et al. (2023) surveyed 60 athletes who trained at two Khelo India sports facilities in northeast India to analyse the impact of the infrastructure on training quality for those teams and athletes. The authors found that 11 of 12 factors related to the training of those athletes, including coaching quality, training facilities, psychological assessment, mentorship, and feeder athlete pipelines, were positively associated with the infrastructure costs. The only factor that was found to be insufficient was the availability of grants from the government. Thus, while the infrastructure in these facilities was associated with high standards of training, the study was too narrow in scope to apply these findings to the remainder of India's athletes.

Finally, a 2025 report by Vishal Pathalia in IIPA Publications examined the infrastructure and implementation of the Khelo India program within the Delhi metropolitan area. The report found that India invested around ₹2,974.55 crore into around 307 projects in 32 states within India, which built 1,031 Khelo India Centres that train 20,495 athletes in the program with an average of around 19.85 athletes per centre. Furthermore, a survey of 201 athletes revealed that the construction of these sports facilities has increased the accessibility of sports to underprivileged communities within the nation, improved scouting for sports talent within the community, and increased the development of sports-related communities and activities. Specifically in Delhi, the presence of world-class sports facilities, such as the Jawaharlal Nehru Stadium, has provided clear benefits to the region; however, the report also noted the lack of funding for the maintenance of these world-class stadiums, as well as the access disparities that still exist for underserved individuals, although they have decreased.

While there are several studies related to India that investigate the infrastructure of Khelo India, highlighting that it is linked with improved training quality and accessibility, there is a gap in the current literature. The studies do not compare outcomes across states within India, and none provide a correlational analysis of the relationship between infrastructure investments and sporting success within the nation.

METHODOLOGY

In this study, a quantitative approach and positivist paradigm were adopted, with cross sectional research design to explore the determinants of youth sports success in Khelo India Youth Games (KIYG), which include infrastructure investment by Khelo India, the number of projects, and the closeness of the host state. The unit of analysis is Indian States or Union Territories, where data has been collected for each of them across three different editions of the KIYG (2022, 2023, and 2025). The sources of data used for the same were solely secondary sources like official documents released by KIYG and through government

files. It should be noted that the data from the 2024 edition of the KIYG was not publicly available from the government sources at the time of this study, and so was excluded from the dataset. No primary research was undertaken. This approach and design are suitable for this study as it necessitates for numbers and figures, while allowing for empirical analysis to determine a relationship between infrastructure investment along with other factors, primarily sporting success. This can be easily done by analysing data that is already publicly available and doesn't require primary data collection, such as surveys or interviews. However, a considerable amount of data processing was undertaken to make the available data usable. The data from several official documents, including PDF documents made publicly available by the government, were digitized and converted into databases using LLM-assisted techniques that enabled the data to be compared between the three editions of the KIYG. All of the collected data was cross-verified and checked with the documents to ensure accuracy and identify any discrepancies.

Readings from the Khelo India Scheme provide details from all the infrastructure projects by Khelo India in all the states, which have been collected through the official Khelo India website. More specifically, it includes the funds sanctioned by the government per project, project name, type of infrastructure, progress of completion, the year that these projects were sanctioned, and additional details. This data was used to calculate the cumulative infrastructure spending per state for the 3 editions and the cumulative project count.

The merit certificates of the athletes who competed in the Youth Games served as the main data source for the analysis of the performance of youth athletes from the participating states of India. The official merit certificate master data was published by the Ministry of Youth Affairs and Sports, a ministry of the Government of India, through the Khelo India website (Khelo India, 2026). Data from three separate editions of the games (2022: held in Panchkula, 2023: held in Chennai, and 2025: held in Patna) were used in this calculation. Each of the datasets includes information regarding the name of each athlete, the name of the state that they represent, the name of the sport in which they competed, the name of the event within that sport, the certificate number for that athlete, the position that they achieved, their KID number, their Player Detail ID, and information regarding their category within the games and the type of sport in which they competed (Individual, Double or Team). The main variables that were collected through these lists included the total number of medals that each state competed in and the cumulative number of medals earned by those states up to the year of the youth games.

Variables

Three categories of variables were used in this research study. The dependent variable was constructed as a measure of the performance of youth athletes from each Indian state in the Khelo India Youth Games. Two independent variables were constructed to measure infrastructure investment in each of these states, as well as a few derived and control variables. Each of the variables within the study was calculated at the state level, using the 2025 cumulative reference point for calculations unless otherwise specified for a particular variable.

Dependent Variable: Cumulative Medal Count

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The dependent variable for this study was the total number of medals earned by each state within the youth games. The total medals earned by each state were calculated as the total number of medals earned by each state between the years of 2022 (Panchkula, Haryana), 2023 (Chennai, Tamil Nadu), and 2025 (Patna, Bihar). Looking at the consecutive three editions as a whole rather than examining them individually helps in accounting for any differences or anomalies in performance between the individual years alone. Thus, this evens out any year-to-year variations caused by other factors like advantages by host state, sport selection across editions, and uneven entry. These certificates were deduplicated to account for the possibility of a team winning a medal and having multiple certificates awarded to its members, reducing the possibility of overcounting athletes within a winning team.

Independent Variable: Infrastructure Investment and Total Projects

Two independent variables were used within the study to measure the infrastructure investment in each Indian state. Each of these variables was drawn from a database that tracked infrastructure projects undertaken by the Indian government for the Khelo India Youth Games. These two variables were calculated as the total number of infrastructure projects in each state, as well as the total funds that were sanctioned for these projects per state in Crore Indian Rupees. Furthermore, the calculation of each of these variables used a cumulative model that counted all infrastructure projects and funds for each state that were established prior to or during each edition of the youth games, avoiding problems like crediting post-games infrastructure to pre-games outcome.

Additional Variables

Variables such as the participation rate of each state or the medal conversion rate of each state's participants were derived variables. The total participation of each state (the number of athletes that each state sent to compete in the KIYG competitions over the three editions) was collected through KIYG's official website and can help to reveal how effective the infrastructure investment was in engaging athletes and encouraging them to participate in the competition. Additionally, the medal conversion rate for each state (the percentage of the total participants from each state who won at least one medal in the three editions of the KIYG) can help reveal how efficient each state was at converting participation into medals. Together, these two variables allow for the study to separate between the effects of investment on the general engagement of youth in sports versus those where athletes actually win medals. These are two different phenomena that may have different relationships with infrastructure development.

The distance between each state's capital city and the youth games host city was calculated using the Haversine formula to determine the distance between two geographic coordinates in kilometres. This variable was constructed to account for the possibility of youth athletes from states that are geographically closer to the host city having a competitive advantage in relation to those from more distant states. The states were divided into two groups according to a 900 km threshold, which represented approximately the median distance of the state capitals from Patna. This threshold resulted in two groups of similar sizes, with 17 states falling within 900 km of Patna, and 19 states lying beyond this distance. Therefore, the

relation between the funding and conversion rate for each of these two groups of states could be studied separately.

Data Analysis

Following data collection, the datasets were all cleaned and merged into one database in Microsoft Excel. The names of the states and union territories were standardized to ensure consistency across the database, using data from the Khelo India Youth Games merit lists, participation lists, and medal tallies (Khelo India, 2026). Within the database, duplicate entries for team sport medals were removed by creating a unique identifier for each state, sport, event, and medal position. Count and funding variables were calculated for each state through the aggregation of the infrastructure data.

The first stage of analysis used descriptive statistics to summarize the data and explore the variables within the database. Variables relating to the total number of medals earned by each state, the infrastructure funding provided to each state, and the projects built within each state were summarized within tables and visualizations. Additionally, descriptive statistics provided information regarding how different variables within the database varied from state to state. Finally, tables and visualizations were used to determine which states performed best in terms of total number of medals earned (such as Maharashtra and Haryana), the funding provided to their sports infrastructure (such as Gujarat), and their performance relative to the funds invested into their sports infrastructure, such as the low performance of Arunachal Pradesh relative to the funds invested into its sports infrastructure.

The final stage of analysis involved the examination of the scatter plots as well as the inclusion of trendlines for these plots. Each of these scatter plots had the total number of medals earned by each of the Indian states plotted against one of the explanatory variables, which represented the independent variable, with a trendline indicating the relationship between the two variables. The coefficient of determination (R^2) for each of these variables helped to explain the extent to which the differences in the total number of medals were accounted for by that specific explanatory variable. For instance, if the R^2 for a specific variable was found to be 0.125, it would indicate that 12.5% of the differences in the total number of medals earned by each state were accounted for by that specific explanatory variable. In addition to reporting the R^2 values for each of the regression models, tests of statistical significance were performed with an F-test statistic, leading to a p-value for each of the relationships. The threshold for significance was set at a p-value of less than .05, such that any relationships with p-values below this threshold were considered to be statistically significant, but those with p-values above this threshold were considered to be inconclusive, irrespective of the R^2 value.

RESULTS

The empirical findings of this research study present the analysis of the relationship between sports infrastructure and competitive outcomes within the Indian states, using data from the 2022, 2023, and 2025 editions of the Khelo India Youth Games. The data for this research study consists of information from each of the 36 states and Union Territories of India, each of which competed in at least one of the editions of the Games.

Table 1 presents the descriptive statistics for each of these variables, providing an overview of the data that will be used in this chapter to conclude the potential relationship between sports infrastructure and competitive outcomes.

During the 2022, 2023, and 2025 editions of the Games, a total of 2,820 medals were awarded to competitors from India's states. The annual totals of the number of medals awarded to each of the editions of the Games were 949 medals in 2022, 985 medals awarded in 2023, and 886 medals awarded in 2025. These figures indicate that while the total number of medals awarded to Indian youth competition in the Games varied slightly from edition to edition, they were similar enough to allow for meaningful comparisons of the competitive outcomes between each year's Games. In addition to the distribution of the medals among the states, the total funding allocated to infrastructure projects for all of India's states and union territories was found to have totalled over 2,171.93 crore rupees by 2025.

In each of these data sets, there is some variation between the outcomes of each of the states. For instance, the state of Maharashtra won the highest total number of medals during the Games. The total number of medals won by the state during the 2022, 2023, and 2025 editions of the Games was 450. In contrast, the state of Ladakh won no medals in any of the three years. Additionally, the funding allocated to each of the states varied. States like Gujarat received over 600 crore rupees in funding allocated to infrastructure projects for the 2022, 2023, and 2025 editions of the Games. Other territories, however, such as Chandigarh, were allocated no funding at all for any of these editions.

Table 1: Medals, projects, and funds across states and editions

State / UT	MEDALS				PROJECTS				FUNDS (₹ Cr)			
	2022	2023	2025	TOTAL (cum.)	2022	2023	2025	Total (cum.)	2022	2023	2025	Total (₹ Cr)
Maharashtra	156	157	137	450	6	6	7	7	35.50	35.50	49.50	49.50

Haryana	119	115	108	342	8	9	10	10	55.09	63.09	70.09	70.09
Tamil Nadu	52	109	62	223	5	5	5	5	29.50	29.50	29.50	29.50
Delhi	63	58	67	188	4	4	6	6	19.14	19.14	46.01	46.01
Rajasthan	48	54	57	159	20	23	25	25	85.53	99.03	112.08	112.08
Karnataka	54	54	51	159	14	15	16	16	79.77	87.53	95.53	95.53
Madhya Pradesh	92	32	24	148	9	9	10	10	43.79	43.79	53.29	53.29
Uttar Pradesh	36	42	52	130	25	26	27	27	136.08	145.63	153.13	153.13
Punjab	33	44	43	120	7	8	10	10	41.22	51.22	74.72	74.72
Kerala	43	38	23	104	4	4	7	7	27.78	27.78	48.63	48.63
Manipur	34	26	29	89	5	5	5	5	23.24	23.24	23.24	23.24
West Bengal	37	33	16	86	0	2	3	3	0.00	17.65	27.15	27.15
Telangana	25	23	22	70	5	5	6	6	22.28	22.28	28.78	28.78
Andhra Pradesh	10	33	24	67	7	8	10	10	30.89	38.39	50.79	50.79
Odisha	30	23	13	66	4	5	5	5	28.00	71.95	71.95	71.95

Gujarat	20	26	13	59	5	5	5	5	606.37	606.37	606.37	606.37
Chandigarh	17	18	17	52	0	0	0	0	0.00	0.00	0.00	0.00
Assam	7	24	24	55	7	8	8	8	43.18	47.68	47.68	47.68
Bihar	7	6	33	46	6	6	8	8	31.32	31.32	47.82	47.82
Jharkhand	7	13	19	39	2	4	5	5	10.38	26.38	32.38	32.38
Uttarakhand	7	16	11	34	5	5	6	6	23.78	23.78	33.28	33.28
Chhattisgarh	10	8	11	29	4	4	8	8	20.65	20.65	48.51	48.51
Himachal Pradesh	8	14	5	27	6	6	6	6	25.16	25.16	25.16	25.16
Jammu & Kashmir	11	8	5	24	5	5	5	5	27.74	27.74	27.74	27.74
Arunachal Pradesh	10	2	3	15	20	20	20	20	156.81	156.81	156.81	156.81
Nagaland	1	1	6	8	6	7	11	11	41.00	44.00	62.58	62.58
Puducherry	2	2	2	6	2	2	2	2	10.25	10.25	10.25	10.25
Mizoram	2	2	2	6	6	7	8	8	34.50	39.00	50.50	50.50
Tripura	1	2	2	5	7	7	7	7	38.33	38.33	38.33	38.33

Medal Distribution Across States:

As shown in Figure 1, the medals won by the different states of India are extremely unevenly distributed. A few states won the majority of medals, while many others only won a few. Maharashtra has won the most medals with 450, followed by Haryana with 342, Tamil Nadu with 223, Delhi with 188, and both Rajasthan and Karnataka with 159 each. These six states have accounted for 53.9% of the total medals won by Indian states (1,521 out of 2,820). Thus, only one-sixth of the states of India won more than half of the medals.

On the other hand, some states have won fewer than 30 medals each. Meghalaya won four medals, Tripura won five, and both Mizoram and Puducherry each won six. Finally, both the Andaman & Nicobar Islands and Lakshadweep each won only one medal. Ladakh did not win any medals at all. Overall, India has their successes in sports concentrated in a few states only. Other states do not appear to have the same level of support for their youth athletes to compete and thrive in such competitions.

Figure 1: Distribution of cumulative medals won across Indian States in a histogram

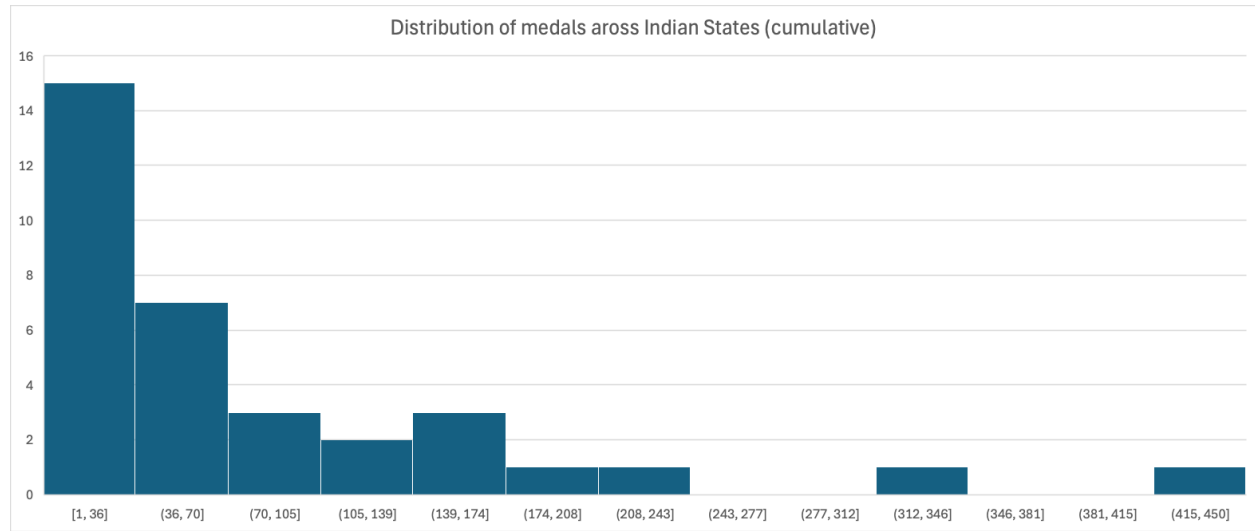
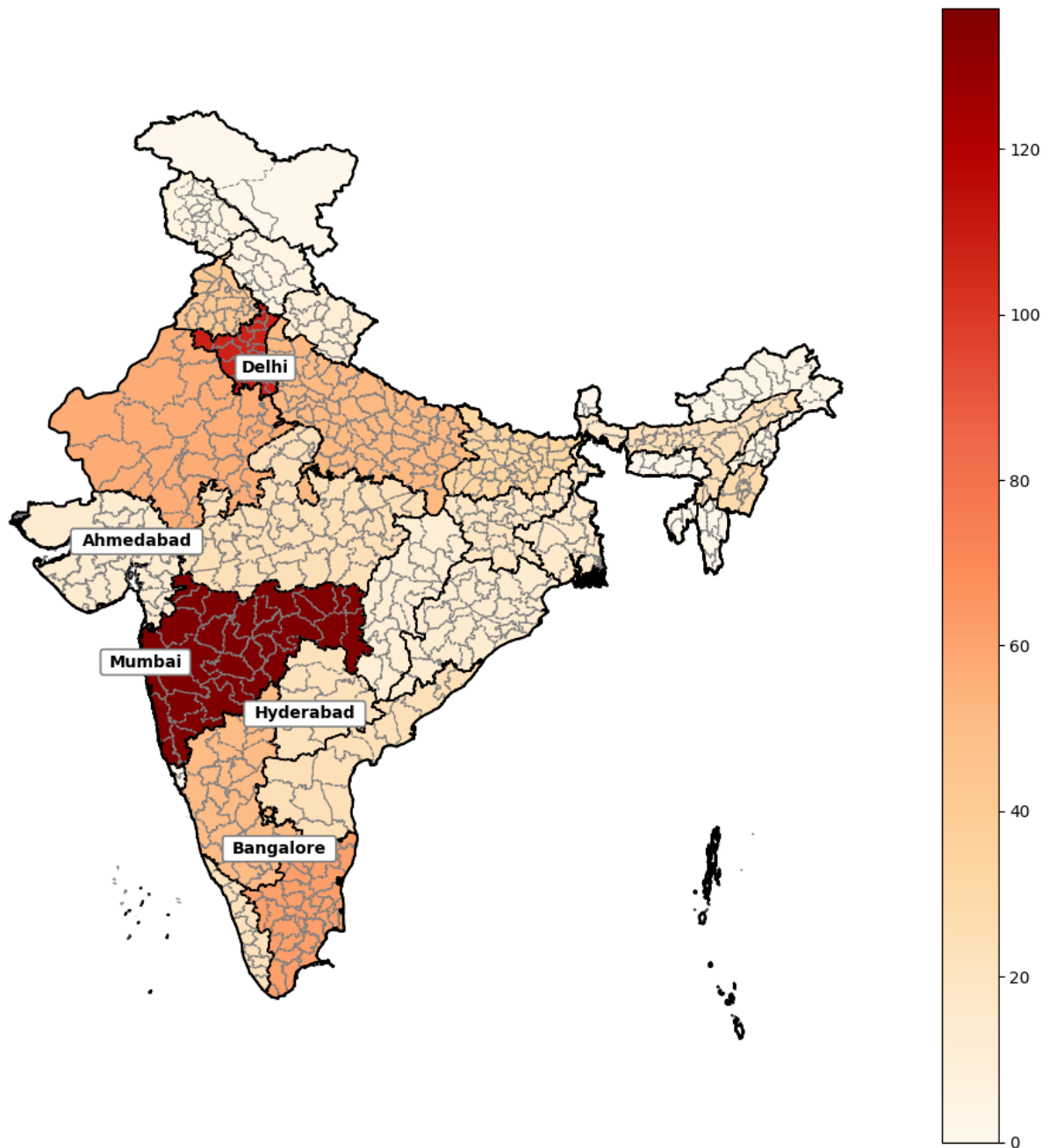


Figure 2 illustrates the spatial distribution of medals won across Indian states. Darker shades of red indicate that a state has won a greater number of medals, and lighter shades suggest that the state has won comparatively fewer medals. Thus, a high number of medals was concentrated among only a few states on the map, with most of the states and union territories in the Indian subcontinent being in lighter shades. This likely reflects the current unequal distribution of sports infrastructure and institutional depth throughout the country, as the states that have had access to better resources in the past have been able to develop more athletes capable of competing at national levels.

Figure 2: Spatial distribution of cumulative medals won across the country

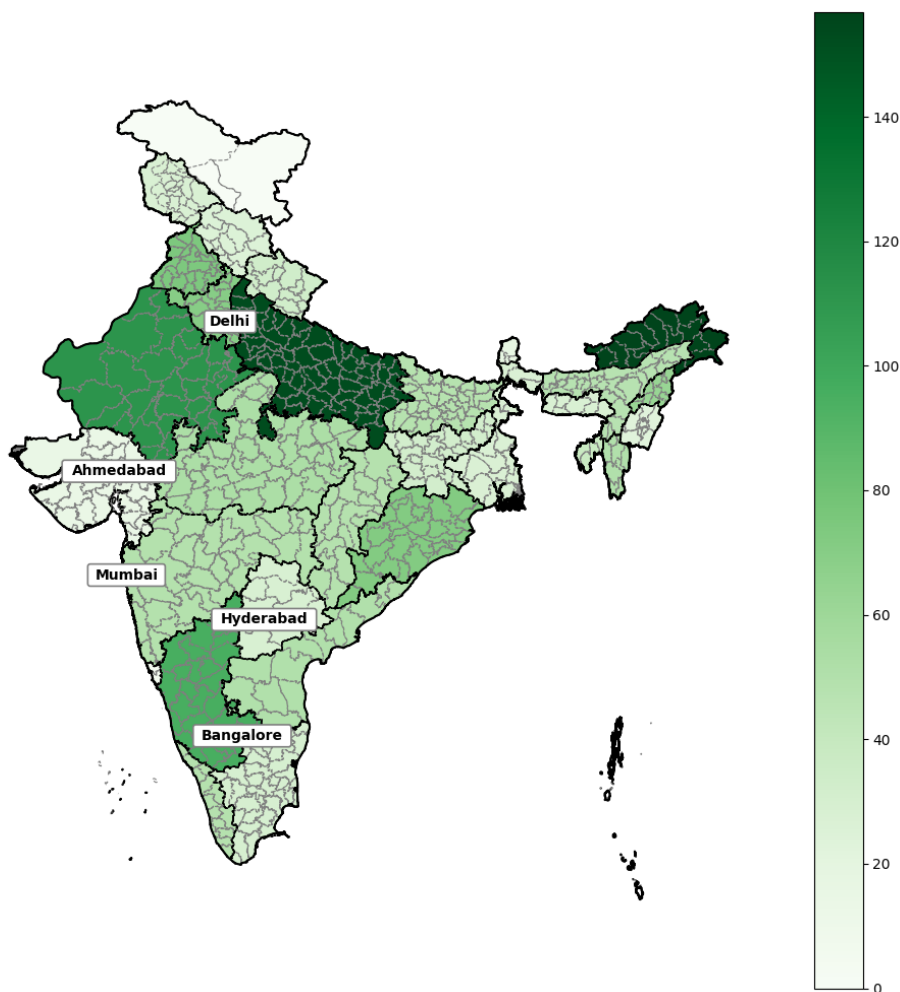


Infrastructure Investment vs Medal Outcomes

The primary objective of this study is to determine whether there is a relationship between infrastructure funding and competitive outcomes in the Khelo India Youth Games. The funding allocated by Khelo India was compared with the number of medals each state and territory earned cumulatively.

The extent of financial investment does not necessarily imply better performance from the states in the Games. As seen in Table 1 and Figure 3, Maharashtra received only ₹49.50 crore but won 450 medals, the highest number of medals won by any of the states. The ratio of the amount of money invested to the number of medals won was the best for this state at approximately ₹0.11 crore of investment for every medal won. Other states, such as Delhi, invested ₹46.01 crore and won 188 medals at a cost of approximately ₹0.24 crore for every medal won. Haryana invested ₹70.09 crore but won 342 medals at a cost of approximately ₹0.20 crore. Thus, these states show a remarkable ability to win a high number of medals with relatively lower investment by Khelo India.

Figure 3: Spatial allocation of funds across the country



However, some of the states with higher levels of funding received did not experience the same success with their athletes. For instance, the state of Gujarat received ₹606.37 crore in funding but only earned 59

medals. Similarly, Arunachal Pradesh received ₹156.81 crore in funding but earned only 15 medals. Thus, despite significant investments in their infrastructure, these states appear to have experienced poor outcomes with their athletes relative to other states.

Figure 4: Scatter plot and linear fit for cumulative funds against the total number of medals (N = 35, $R^2 = 0.097$, $p = .069$)

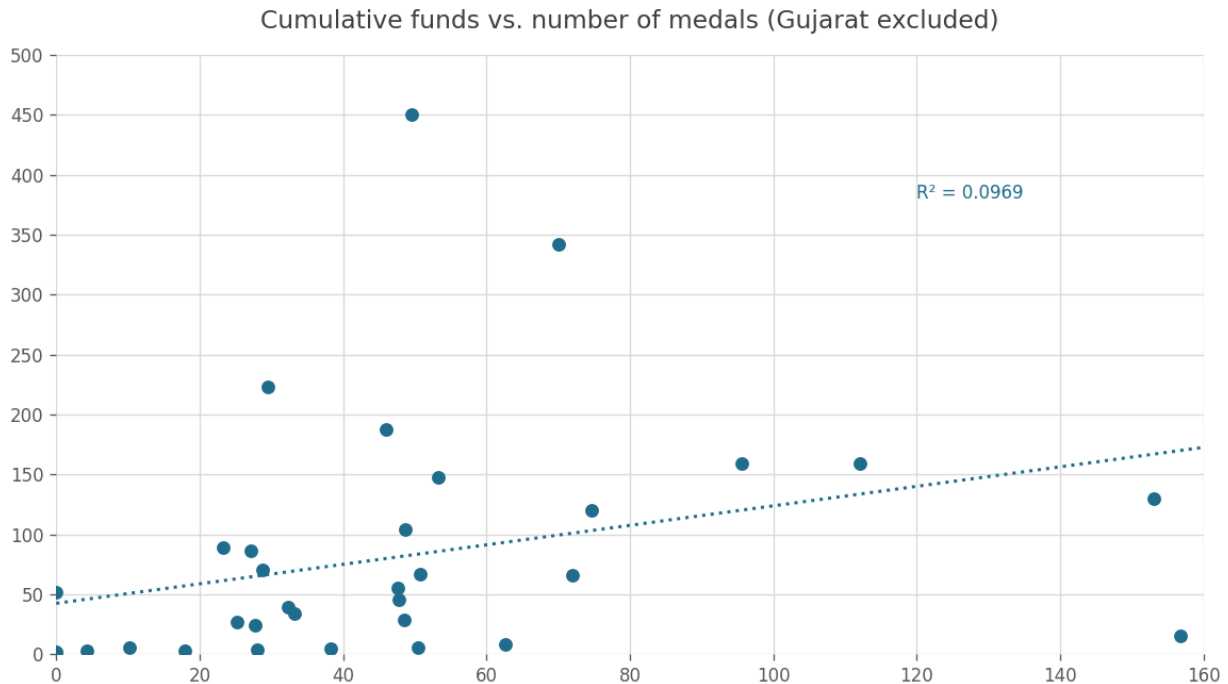


Figure 4 depicts the linear fit estimated using the total number of medals won by each state as the dependent variable and the infrastructure investment for each state by the Khelo India program as the independent variable. Gujarat was excluded from this analysis due to its identification as an extreme outlier in a Cook's Distance test ($D = 9.76$ for Gujarat, compared to 0.21 for the next-highest state). Gujarat received the highest level of funding of any state (₹606.37 crore, compared to ₹153.13 crore for the next-highest state, Uttar Pradesh) yet won a comparatively modest number of medals (59). The linear model excluding Gujarat yields an R^2 value of 0.097, indicating that 9.7% of the variation in the total number of medals won by the states can be explained by the funding provided to each state. Furthermore, this relationship is not statistically significant, $F(1, 33) = 3.53$, $p = .069$, $n = 35$. When Gujarat is included in the analysis, the R^2 value drops to 0.007 ($p = .619$, $n = 36$), illustrating the extent of this single state's influence on the model. In either case, however, there is no statistically significant relationship between funding and the number of medals won by the states.

These results have several implications. First, irrespective of the inclusion of Gujarat, the funding provided to each state does not have a statistically significant relationship with the number of medals its athletes win. Second, the influence that the inclusion of Gujarat has on the R^2 value of the model illustrates the power of small sample sizes in statistical analysis; a single data point has a substantial influence on the model's results. Third, these results indicate that other variables should be examined for their potential relationship to the number of medals won by athletes from each state. Thus, the funding allocated to each state for Khelo India cannot be considered a reliable predictor of the number of medals that athletes from those states will win. However, it is potentially still a necessary variable for enabling athletes from those states to win medals, though not a sufficient one.

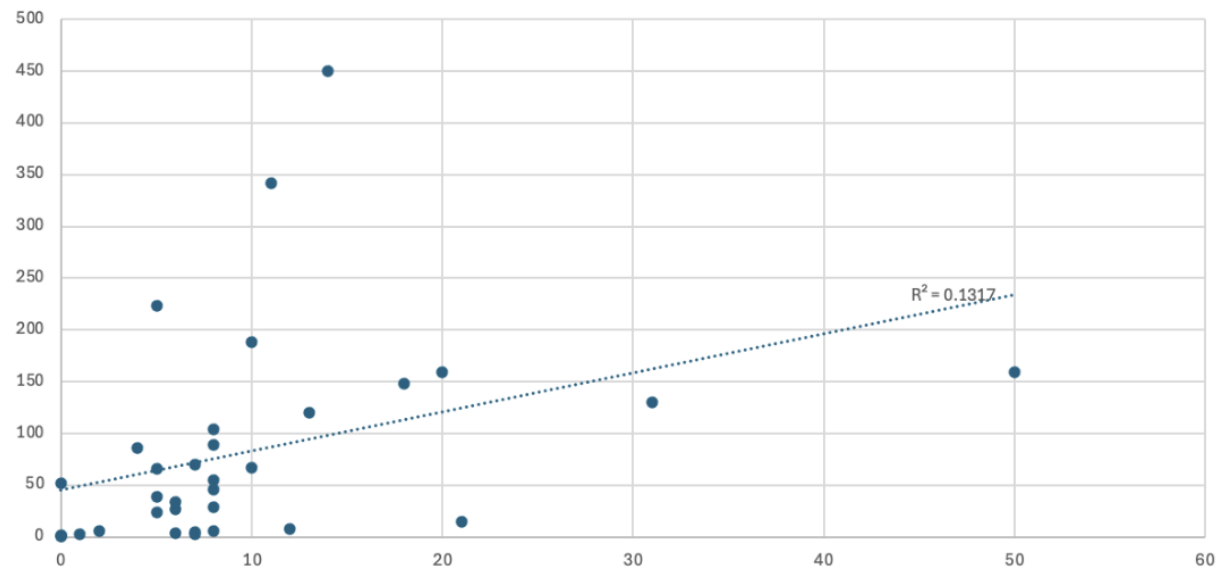
Number of Projects vs Medal Outcomes

A second relationship that was examined in this report was that between the number of infrastructure projects that had been sanctioned within each state and the number of medals that were won by those states during each edition of the Khelo India Games.

The number of projects sanctioned and the number of medals won by each state differed considerably throughout the data. Uttar Pradesh had the highest number of projects (27) and won 130 medals overall. Rajasthan had 25 projects but won 159 medals. Arunachal Pradesh had 20 projects but won only 15 medals. Maharashtra only had 7 sanctioned projects but won the greatest number of medals (450). Haryana had 10 projects and won 342 medals. Delhi had 6 projects and won 188 medals.

Among the states that won fewer medals, Nagaland had 11 projects but won 8 medals. Mizoram had 8 projects and won 6 medals. Tripura had 7 projects but won 5 medals. Chandigarh won 52 medals but had no projects sanctioned for it. Finally, both Lakshadweep and the Andaman & Nicobar Islands had no sanctioned projects, but each won one medal in the Games.

Figure 5: Scatter plot and linear fit for cumulative projects against the number of medals (N = 36, $R^2 = 0.132$, $p = .030$)



The linear fit shown in Figure 5 was plotted with the medal count for each state as the dependent variable and the number of projects as the independent variable, which had a coefficient of determination of 0.1317. Thus, 13.17% of the total variation in the number of medals that were won by the states was associated with the number of infrastructure projects that had been sanctioned within those states. This relationship was statistically significant, $F(1, 34) = 5.16$, $p = .030$.

The scatter plot for these two variables exhibited a slight positive trend. In other words, states with more sanctioned projects tended to win more medals than those with fewer projects. However, the dispersion of each state's data points on the scatter plot indicated that there were considerable differences within the medal counts of states that had similar numbers of sanctioned projects. For instance, while both Maharashtra and Tamil Nadu had fewer than 10 sanctioned projects, the number of medals that were won by each state differed considerably (450 vs. 223). However, Arunachal Pradesh had 20 sanctioned projects but won only 15 medals.

Thus, although there is a positive relationship between the number of infrastructure projects sanctioned within a state and the number of medals won by the athletes from that state, such a relationship is relatively weak.

Participation and Medal Conversion

While the total number of medals won by each state is an essential metric to consider, the ratio of the number of medals won to the number of athletes sent to compete in these Games is a more precise

indicator of the quality and efficiency of the athletes by state. On average, the states that sent athletes to compete in these Games had 19.9% of those athletes win a medal. However, the percentage of athletes winning medals varied considerably from state to state.

As seen in Table 2, Maharashtra has the highest percentage of athletes winning medals at 38.8%: they won 450 medals from 1,160 athletes that were sent to compete in these Games. Haryana follows closely behind at 28.6% (342 medals from 1,194 athletes), followed by Karnataka at 23.9% (159 medals from 665 athletes), Delhi at 23.5% (188 medals from 801 athletes), and Manipur at 22.1% (89 medals from 402 athletes).

Bihar, in contrast, sent 469 athletes to compete in 2025, which is the largest number of athletes by a state in that edition. However, their athletes earned only 33 medals for the nation at a conversion rate of 7.1%, which was calculated by dividing the cumulative medals by the total participation. This is typical of states that host these Games. They send more athletes to compete in the Games, but often those athletes do not win medals. Similarly, Tamil Nadu sent 497 athletes to compete in 2023 as they were hosting the Games for that year, earning a medal percentage of 21.8%, which is above the national average, but also since it included participants who would not have otherwise qualified under stricter criteria.

Finally, Ladakh and Meghalaya have the lowest rates of athletes winning medals for their countries: 0.0% and 3.8,% respectively. Ladakh earned 0 medals from its 37 athletes' participations in 2022 and 2023.

Table 2: Participation and conversion rates across states and editions

State / UT	Part. 2022	Part. 2023	Part. 2025	Total Part.	Cum. Medals	Conv. Rate %
Andaman & Nicobar Is.	0	0	10	10	1	10
Andhra Pradesh	93	86	116	295	67	22.7
Arunachal Pradesh	78	15	32	125	15	12

Assam	75	74	101	250	55	22
Bihar	114	68	469	651	46	7.1
Chandigarh	134	120	96	350	52	14.9
Chhattisgarh	107	128	105	340	29	8.5
Dadra & NH and D&D	13	0	23	36	2	5.6
Delhi	248	232	321	801	188	23.5
Goa	30	47	50	127	3	2.4
Gujarat	114	140	102	356	59	16.6
Haryana	470	371	353	1194	342	28.6
Himachal Pradesh	64	62	59	185	27	14.6
Jammu & Kashmir	46	57	53	156	24	15.4
Jharkhand	94	137	191	422	39	9.2

Karnataka	231	207	227	665	159	23.9
Kerala	243	157	148	548	104	19
Ladakh	19	18	0	37	0	0
Lakshadweep	14	11	10	35	1	2.9
Madhya Pradesh	463	192	182	837	148	17.7
Maharashtra	360	374	426	1160	450	38.8
Manipur	144	94	164	402	89	22.1
Meghalaya	42	19	43	104	4	3.8
Mizoram	26	44	34	104	6	5.8
Nagaland	19	9	26	54	8	14.8
Odisha	152	138	178	468	66	14.1
Puducherry	22	93	28	143	6	4.2

Punjab	212	227	248	687	120	17.5
Rajasthan	215	219	302	736	159	21.6
Sikkim	14	4	14	32	3	9.4
Tamil Nadu	231	497	296	1024	223	21.8
Telangana	129	107	67	303	70	23.1
Tripura	10	63	12	85	5	5.9
Uttar Pradesh	280	220	269	769	130	16.9
Uttarakhand	36	50	67	153	34	22.2
West Bengal	180	158	167	505	86	17

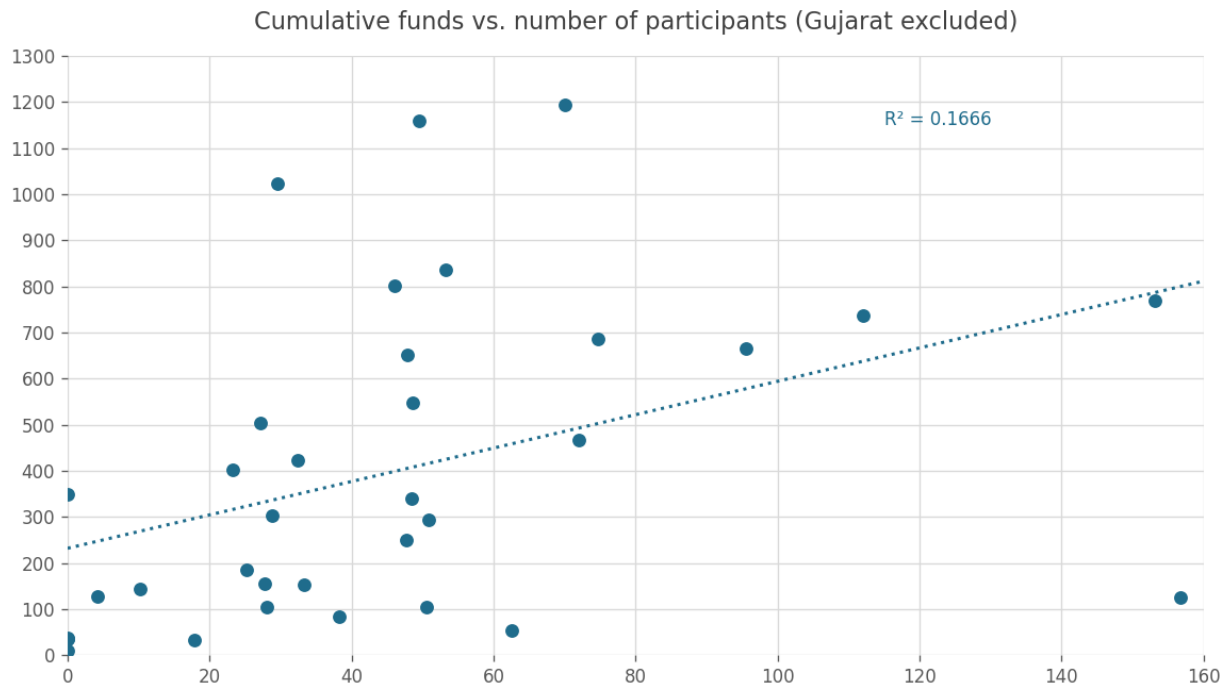
Number of Participants vs. Infrastructure Funding

Figure 6 displays the relationship between the amount of infrastructure that was invested into each of the states and the total number of participants from each of those states in the Khelo India Games. Gujarat was excluded from this dataset due to its extreme value in Cook's Distance relative to the other states ($D = 16.19$, compared to 0.08 for the next-highest value, Haryana). The same pattern was observed in Figure 4. The coefficient of determination (R^2) for the graph is 0.167 for states without Gujarat included in the analysis. This value indicates that the funding provided to each state explains 16.7% of the variation in the

total number of participants from each state. Furthermore, the relationship between funding and the number of participants is statistically significant ($F(1, 33) = 6.60, p = .015, n = 35$). If, however, Gujarat is included in the dataset, the R^2 value decreases to 0.018 ($p = .430, n = 36$), indicating the influence that this one state has upon the relationship.

States with higher funding allocations for their infrastructure tended to receive higher numbers of participants. For instance, states like Maharashtra received approximately 49.50 crore in funding for their infrastructure and had 1,160 participants from the state. Additionally, Haryana received 70.09 crore in funding and had the highest number of participants during the three editions of the Games, with 1,194 athletes participating overall. However, states with higher funding did not always have higher numbers of participants. An extreme case of this is that while Gujarat received the highest allocation of funding for infrastructure at 606.37 crore, the state received only 356 participants. Additionally, states like Tamil Nadu had 1024 participants yet received only 29.50 crore in funding for infrastructure.

Figure 6: Scatter plot and linear fit for the number of participants against total funds ($N = 35, R^2 = 0.167, p = .015$)

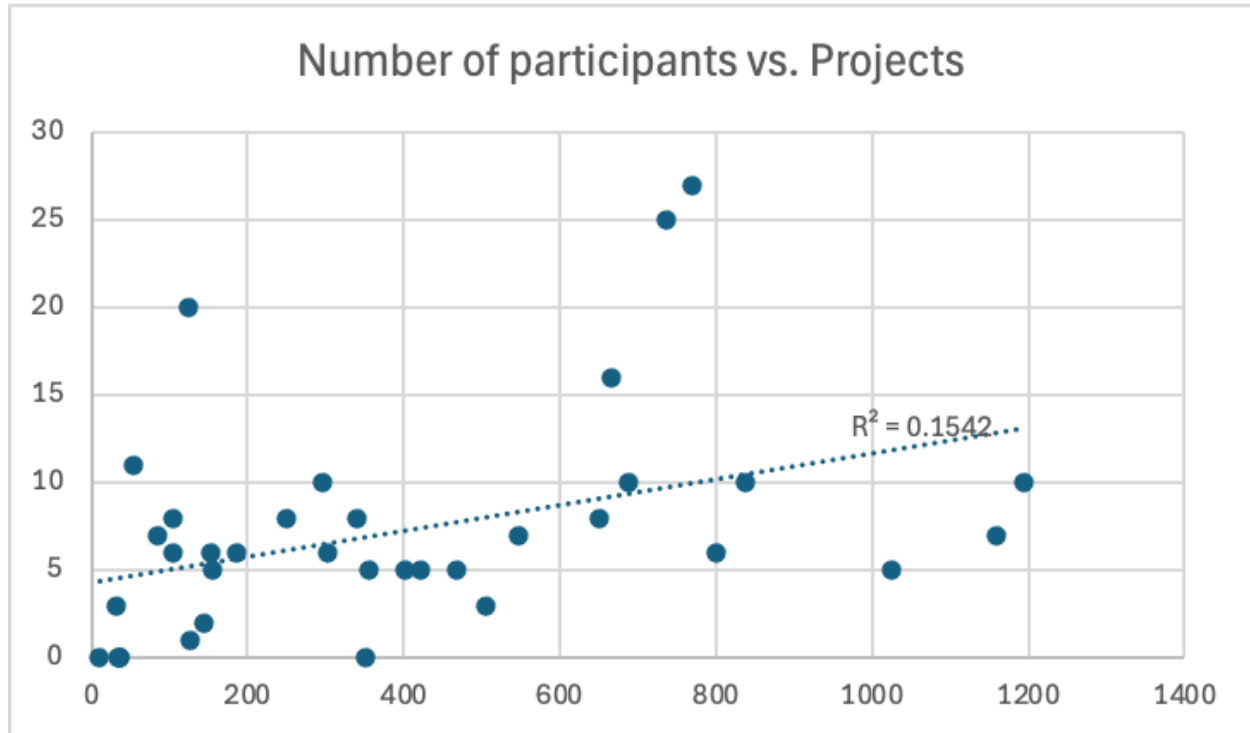


Number of Participants vs. Number of Projects

The relationship between the number of projects constructed within each state and the number of participants from that state within the Games was analysed in Figure 7. The R-squared value for this relationship was 0.1542, indicating that 15.42% of the variation in the total number of participants from each state within the Games is explained by the difference in the number of infrastructure projects constructed within each state. This relationship was statistically significant, $F(1, 34) = 6.20$, $p = .018$.

States that constructed more infrastructure projects within their states tended to draw more participants from those states. For instance, Uttar Pradesh constructed 27 infrastructure projects within the state, which drew 769 participants from the state. Additionally, Rajasthan constructed 25 infrastructure projects within the state, and had 736 participants from the state, and states like Karnataka constructed 16 infrastructure projects and had 665 participants from the state. However, some states that constructed fewer projects within their states had relatively more participants from those states as well. For instance, states like Maharashtra constructed only 7 infrastructure projects yet had 1,160 participants, and states like Tamil Nadu constructed only 5 infrastructure projects within the state yet drew 1,024 participants from the state. By contrast, Arunachal Pradesh constructed 20 infrastructure projects within the state, but only received 125 participants from the state overall.

Figure 7: Scatter plot and linear fit for the number of participants against the total projects ($N = 36$, $R^2 = 0.154$, $p = .018$)



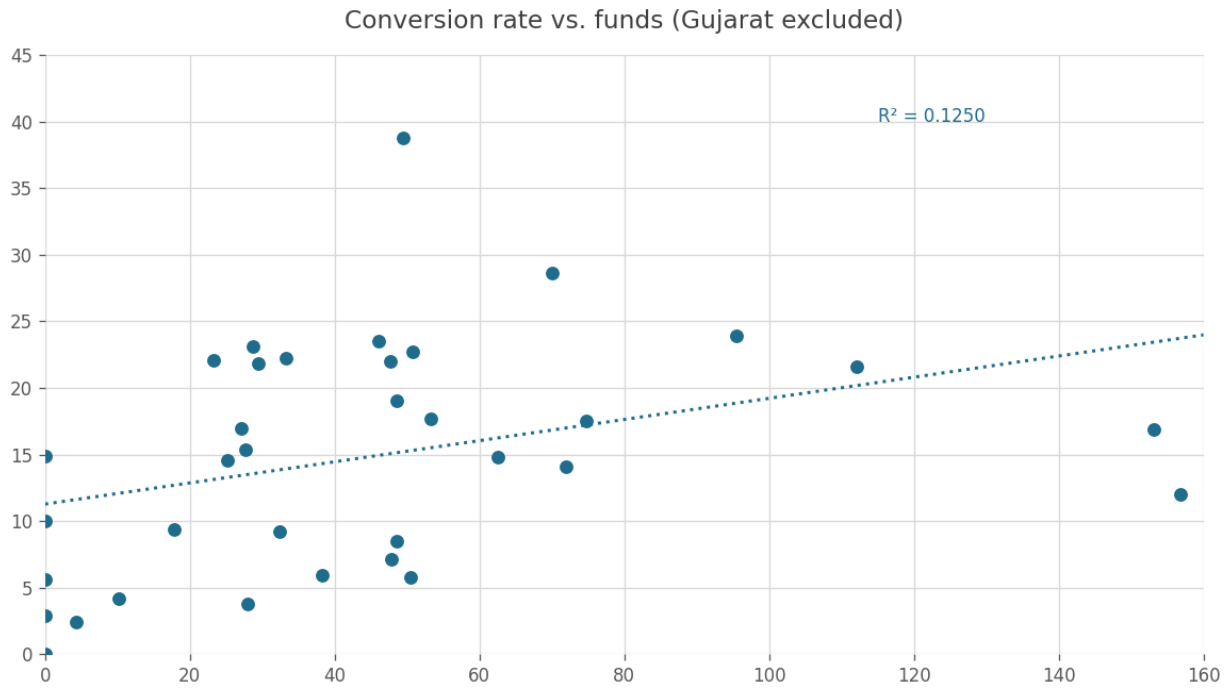
Conversion Rate vs. Infrastructure Funding

The next relationship to be analysed was the relationship between the infrastructure funding provided to each state and the conversion rate of athletes from those states in the Khelo India Youth Games. Again, Gujarat was excluded from this analysis, having been identified through a Cook's Distance test as an extreme outlier in relation to the other states ($D = 10.88$ for Gujarat, compared to 0.12 for the next-highest scoring state, Maharashtra), the same result as obtained for Figures 4 and 6. The results of the regression model for this dataset (excluding Gujarat) indicated that the R-squared value was 0.125, indicating that funding for infrastructure was able to explain 12.5% of the variation in conversion rate for each state. Additionally, the model was statistically significant, with an F-value of 4.71 and a p-value of .037. If, however, the data for Gujarat is included in the analysis, the R-squared value drops to 0.027 ($p = .337$, $n = 36$), indicating the extent to which Gujarat influences the relationship being analysed.

Several states had high conversion rates, even with relatively low infrastructure funding provided to each state. For instance, both Maharashtra and Haryana had high conversion rates of 38.8% and 28.6%, respectively, with low allocations of funding of 49.50 crore and 70.09 crore for infrastructure within each state. Additionally, states like Karnataka had a relatively high conversion rate of 23.9%, with 95.53 crore in infrastructure funding for the state. In contrast, states like Gujarat had a relatively low conversion rate

of 16.6% with the highest allocation of funding for infrastructure within the Games. Arunachal Pradesh also had a low conversion rate of 12.0% with 156.81 crore in infrastructure funding.

Figure 8: Scatter plot and linear fit for conversion rate against total funds across states (N = 35, $R^2 = 0.125$, $p = .037$)



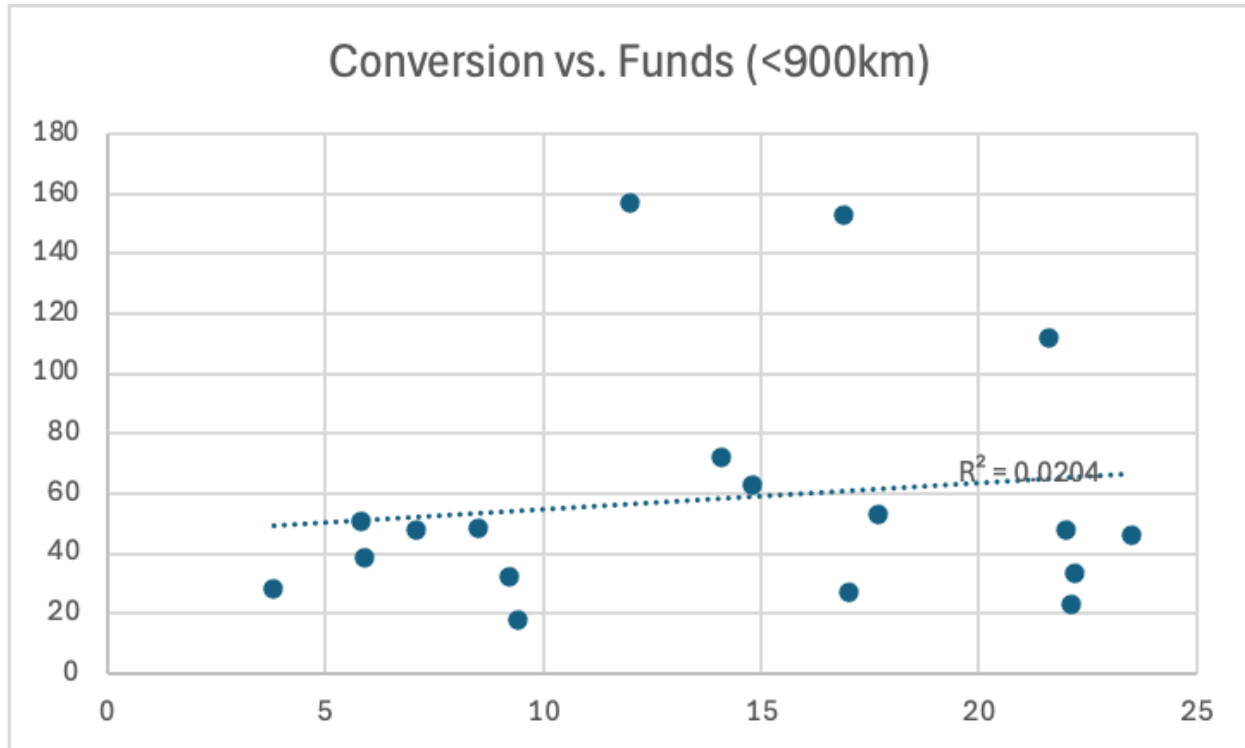
Building on the general relationship between the funds allocated to each state and the medals that are converted from those funds, the data can be further broken down according to the distance of the states from the host city, Patna, in the 2025 edition. The data can be split at the 900 km threshold to determine if there is any relationship between that distance and the relationship between allocated funds and conversion rates.

States within 900 km of Patna

Of the 17 states within 900 km of Patna, the data relating the conversion rate of each state with the funds allocated to each state returns an R^2 value of 0.0204, as seen in Figure 9. This relationship was not statistically significant, $F(1, 15) = 0.31$, $p = .584$. The relationship between the two variables is, therefore, near negligible. States like Delhi and Manipur have conversion rates of above 1.0 medal per crore of funding, while states like Arunachal Pradesh, which allocated the highest amount of funds to the Games at ₹156.81 Cr, have some of the lowest medal conversion rates. The proximity to the host city may reduce

travel costs, even for smaller and less developed states, allowing for larger contingents. However, having a larger contingent does not necessarily mean that there will be more medals. The near-zero coefficient of determination indicates that the existing sporting infrastructure of a state is a greater determinant of conversion rates than the funding allocated.

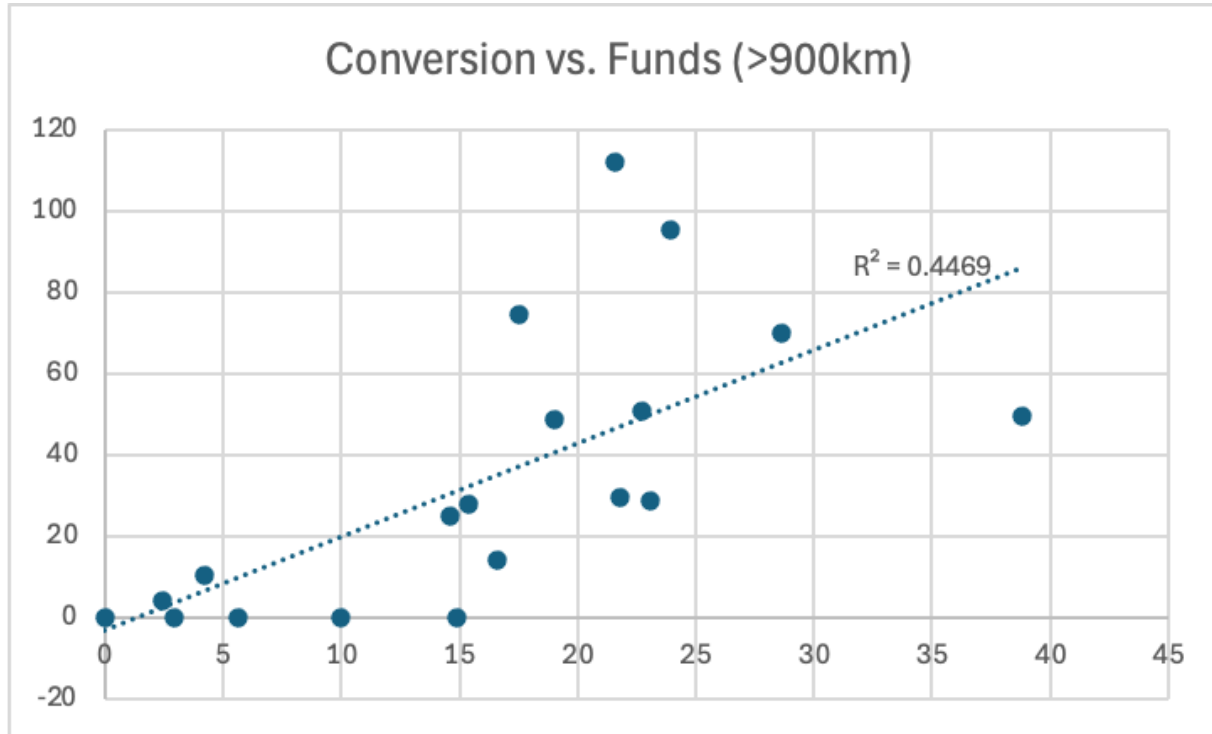
Figure 9: Scatter plot and linear fit for conversion rate against funds across states less than 900km from the 2025 edition host state: Patna. (N = 17, $R^2 = 0.020$, $p = .584$)



States beyond 900 km from Patna

For the 19 states located at distances beyond 900 km from Patna, the R^2 value of the model is 0.4469, as seen in Figure 10, indicating that the amount of funds allocated to each state explains 45% of the variation in the conversion rate, a stronger relationship than that of the states within 900 km of Patna. This relationship was statistically significant, $F(1, 17) = 13.74$, $p = .002$. Since distance can serve as a proxy for the cost of participation, the difference in results between these two scenarios indicates that there is a change in the relationship between funding and the conversion rate when the cost of participation becomes a more significant factor. States like Maharashtra and Tamil Nadu have moderate funding but have a higher conversion rate, while the states that are more distant from the host state and have minimal funding obtain significantly fewer medals, creating the upward trend in the data.

Figure 10: Scatter plot and linear fit for conversion rate against funds across states more than 900km from the 2025 edition host state: Patna. (N = 19, $R^2 = 0.447$, $p = .002$)

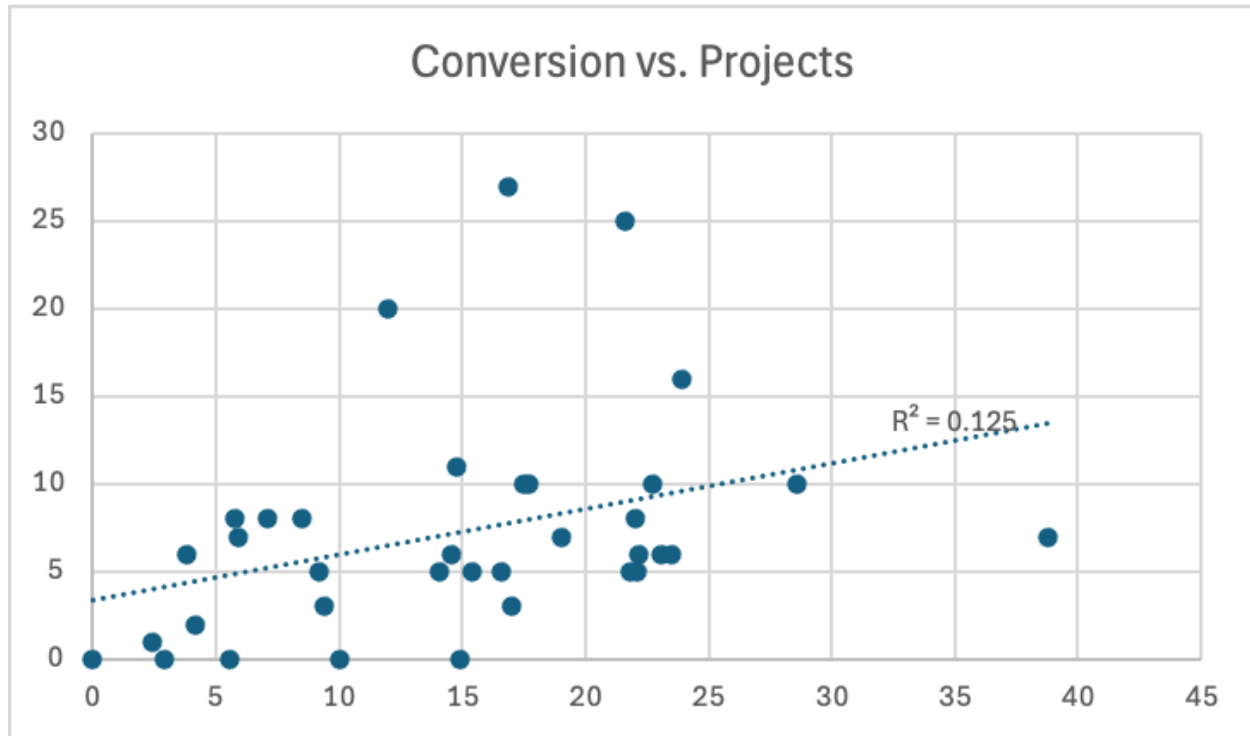


Conversion Rate vs. Number of Projects

The final relationship that was analysed was between the number of projects per state and the conversion rates of the participants from those states, in Figure 11. The R-squared value for this relationship was 0.125, indicating that 12.5% of the variation in the conversion rates of the participants is explained by the difference in the number of infrastructure projects constructed within each state. This relationship was statistically significant, $F(1, 34) = 4.86$, $p = .034$.

Some states that constructed fewer infrastructure projects within their states had higher conversion rates for their athletes within the Games. For instance, Maharashtra, which constructed only 7 projects, had the highest conversion rate of 38.8%. Additionally, states like Delhi that constructed 6 infrastructure projects had a relatively high conversion rate of 23.5% for their athletes. Haryana constructed 10 infrastructure projects within the state and had a conversion rate of 28.6%, and Karnataka constructed 16 infrastructure projects while having a relatively high conversion rate of 23.9%. On the other hand, states like Arunachal Pradesh that constructed 20 infrastructure projects within their state had relatively low conversion rates of 12.0% for their athletes. Additionally, states like Uttar Pradesh, which constructed 27 infrastructure projects, had a conversion rate of only 16.9% for participants.

Figure 11: Scatter plot and linear fit for conversion rate against total projects across states (N = 36, $R^2 = 0.125$, $p = .034$)



Host-State Advantage:

Each of the three editions of the KIYG was hosted by a different state. In each of these cases, the state that hosted the Games recorded a substantial increase in the number of medals that it won relative to its performances in non-hosting editions of the Games.

The state of Tamil Nadu, which won 52 medals in 2022, won 109 in 2023, when it hosted the Games in Chennai, and 62 in 2025. Thus, when it hosted the Games in 2023, it won 57 additional medals or 109.6% of its medals relative to 2022, though its performance in 2025 appears to be returning to its pre-hosting performance levels. Similarly, Bihar, which earned 7 medals in 2022 and 6 in 2023, earned 33 in its hosting year in 2025, which is a 450% increase in its medal count during its hosting year. Furthermore, the number of athletes that represented Bihar in 2025 grew to 469, up from 114 and 68 in 2022 and 2023, respectively.

While Haryana does not have a pre-2022 baseline from which to compare the team's performance, its number of 119 medals earned during its hosting of the 2022 Games is the highest number of medals earned by any state during any of the three editions of these games. Furthermore, its consistent performance of 115 and 108 in the following years without hosting the games indicates a structural dominance by the state instead of solely situational success.

Table 3: Host-State Medal Performance across Editions

Host State	Year Hosted	Athletes Sent (host yr)	Medals Prev. Ed.	Medals Host Year	Medals Next Ed.	Change (Prev to Host)	% Change	Average % Change (other states)
Haryana	2022	470	N/A	119	115	—	—	
Tamil Nadu	2023	497	52	109	62	+57	+109.6 %	+11.08%
Bihar	2025	469	6	33	TBC	+27	+450.0 %	6.19%

To contextualize these figures, the percentage change in the number of medals that were won by each of the non-hosting states between the preceding and the current edition of the Games was calculated. The average percentage change was found to be 11.08% in 2023 for the states that did not host the Games, yet Tamil Nadu experienced an increase in the percentage of medals won of 109.6% as hosts. In 2025, the average percentage change for the other states of India was 6.19%, yet Bihar experienced an increase in the percentage of medals won of 450.0% as the host. In both cases, these figures indicate that the hosting of the KIYG is associated with an increase in the percentage of medals that are won by the state, supporting the common observation of the home advantage in sports competitions.

ANALYSIS

The first major finding from conducting a regression analysis of the data is that even though there is a positive correlation between funding levels and the medals that are won by each Indian state, the R^2 value of the relationship between these two variables is 0.125, evident in Figure 4. Thus, 87.5% of the variation in medals that are won by each of the states within India is explained by factors other than those related to the investment in its sports infrastructure by Khelo India. This is a significant finding regarding the ability and success of the Khelo India program, because it was assumed that an increase in investment in sports

infrastructure would lead to substantial improvements in youth sporting success. Therefore, investment does not directly translate to performance.

For instance, states like Maharashtra and Gujarat have vastly different costs associated with their medals. Maharashtra received only ₹49.50 crore in funding for its sports infrastructure projects, yet the state earned 450 medals, which is the highest in the nation, as seen in Table 1, indicating a cost of only approximately ₹0.11 crore per medal. In comparison, Gujarat received ₹606.37 crore of funding, but only earned 59 medals from those projects, at a cost of approximately ₹10 crore per medal. This data does not suggest that the investments made into infrastructure in Gujarat were wasted; it suggests that the conditions necessary to develop athletes were not present to the same degree in Gujarat as in other states like Maharashtra or Haryana. Reports of the Indian Institute of Sports and Medicine note the issue with infrastructure in India generally, suggesting that most of the sports infrastructure within the nation is utilized to hold competitions rather than for the daily training of athletes, and often has occupancy rates within its facilities of less than 50% throughout the year. Thus, facilities that lie unused for most of the year are incapable of developing athletes for the nation's sports competitions, regardless of the cost of their construction.

Similarly, other states that received substantial funding but earned few medals include Arunachal Pradesh and Uttar Pradesh, which received ₹156.81 crore and ₹153.13 crore, respectively, and earned only 15 and 130 medals, respectively. Both states have some of the highest levels of funding for their infrastructure projects, yet continue to fall short of the medal counts of states like Maharashtra, Haryana, and Tamil Nadu. What distinguishes the high-performing states is not the investment made by Khelo India but the sporting ecosystems that already existed in these states before the establishment of the Khelo India program.

Participation as the Intended Outcome

Another interpretation of these findings may be that the number of medals earned by each state is not the most appropriate measure of what Khelo India is trying to increase. Instead, the goal of the program may be to encourage the participation of athletes from across states in the competitions that are held each year. Accordingly, funding was correlated with the number of participants in the Khelo India Youth Games, and the results of that calculation indicated that funding was responsible for 16.56% of the differences in the number of participants from each state, as seen in Figure 6. Thus, infrastructure was doing a better job of encouraging athletes to participate in the Khelo India competitions than it was encouraging those athletes to earn medals.

An assessment of the number of athletes from each state that participated in the competition indicates that the states that received higher funding to improve their infrastructure projects also sent a greater number of athletes to participate in the competitions. Uttar Pradesh, with 27 sanctioned projects, sent 769 athletes to participate. Other states with many projects also sent numerous athletes to compete in the Khelo India Games, such as Rajasthan, which received 25 projects to improve its sports infrastructure projects and sent 736 athletes, as seen in Figure 7. These are quite substantial numbers for states that traditionally

underperform in competitions. The issue is not that athletes don't show up to compete, but with the systems that exist to develop athletes who can compete at higher levels. The national average conversion rate is 19.9%, but some states are as high as Maharashtra at 38.8%, while others, like Bihar, are as low as 7.1% or 0% in the case of Ladakh, as observed in Table 2. This gap between participation and success is the true challenge for the program and cannot be tackled through the development of sports infrastructure alone.

Furthermore, Singh's (2024) determination of the reason for the differences in these rates is essential to understanding the situation: his research determined that the quality of the coaches that are working with and train these athletes has a greater impact on the outcome of athletes competing in sports than the number of sports infrastructure projects that each state initiates.

The Host-State Effect and What It Reveals

Another of the most important findings of this research is the effect that the hosting of the Khelo India Youth Games has on the number of medals that are won by each state. This phenomenon is well-documented in the existing sports literature internationally. For instance, research into the Summer Olympic Games has found that the host nation of the Games wins significantly more medals than they would at other Games, primarily driven by decreased travel costs, a familiar home stadium, and more fan support (Csurilla & Fertő, 2023). In the Khelo India Youth Games, for instance, the state of Tamil Nadu saw a 109.6% increase in the number of medals that it earned during the year in which it hosted the games relative to its medal count prior to hosting, and Bihar experienced a 450% increase in the number of medals that it won while it was hosting the Games, as seen in Table 3. These outcomes of the Games are unrelated to the sports infrastructure that the states have built over time. Instead, those hosting states experience increased medals due to the reduction of the qualification requirements for competitors, the increased delegation of athletes from those states to compete, the increased attention to sports in those states while they are hosting the Games, and the competitive advantage that comes from athletes competing in their home sports venues.

The fact that the medal counts of a state can increase by 450%, partly due to proximity, motivation, and the attention that the Games provide to the hosting state, indicates that the non-hosting states' medal counts must logically decrease due to the effort and cost of travelling to compete in the Games. The return of Bihar to its pre-hosting levels following 2025, anticipated based on Tamil Nadu, which dropped to 62 medals in 2025 following its peak of 109 medals after it hosted the Games in 2023, indicates that hosting creates only a temporary increase in the number of medals obtained by the nation. This finding has implications for policy decisions regarding hosting the Games. For instance, if the Games are to be held with the intention of developing athletic talent from all states of India, the current practice of hosting the Games in different locations each year inadvertently creates disadvantages for those states that must travel extensive distances to participate in the Games. A potential solution to this problem would be to instead host individual sports within different regional locations of the nation rather than hosting the entire Games within a single state.

Haryana's case complicates the scenario in an instructive manner. Haryana won 119 medals in 2022 as the host of the Games, yet 115 and 108 medals in 2023 and 2025, respectively, despite not hosting the Games in any of those years. Haryana has a consistent performance in the Games due to the number of academies in the region for wrestling, athletics, and boxing, all of which exist and operate independently of the Games. Thus, Haryana's strong performance in 2022 as the host state for the Games was amplified by its strong foundation for developing medal contenders, but its continued performances despite the absence of Haryana as the host of the Games indicate that this is the model that other states should aspire to, though the investment made into Khelo India is merely one of many necessary conditions to attain such an outcome.

The Significance of Conversion Rate

Another measure that can help to explain the medal counts of Indian states is the conversion rate of the athletes who participated in the Games. This measure is considered to be the most important in understanding the outcomes and abilities of the Khelo India program, as the conversion rate data strips away the impact of the delegation of athletes to each state, and considers the performance of those athletes who compete in the Games. The determination of the impact that infrastructure had upon the conversion rate of athletes to medals revealed that funding explained 11.95% of the differences in the conversion rate of athletes between states, as seen in Figure 9. Furthermore, the project count in a state had an impact on the conversion rate of that state's athletes, with only 12.5% evident in Figure 11. These rates indicate that the factor that impacts a state's success is not its infrastructure or the number of its athletes that participate, but those factors that relate to its athletes' developing skills in the sports that they compete in the Games.

India's high-conversion-rate states, such as Maharashtra and Haryana, which earned rates of 38.8% and 28.6%, respectively, are states that have established for many decades a culture of participating in sports, encouraging athletes from schools to compete in various sports, and implementing incentives for athletes to succeed in those sports through their government agencies. In contrast, states such as Gujarat, only 16.6% of the athletes that participated won medals for their states despite receiving the highest level of funding of any state. Arunachal Pradesh at 12.0% with ₹156 crore, and Uttar Pradesh at 16.9% with ₹153.13 crore, as seen in Table 2, each has yet to establish those systems for developing athletes that compete in the nation's youth games. Singh's analysis of sports participation in India determined that although a state may possess the infrastructure, it may not allocate time for athletes to participate in physical activity, or it may not employ coaches with knowledge of and experience in teaching the athletes' sports. Additionally, a report (IISM, 2024) also found that the complex guidelines and regulations of the Khelo India program make it difficult for the states to utilize the funding that is provided to them and often incur delays in the use of that funding and grants due to the bureaucratic structures within the governments of those states.

What the Findings Mean for the Program

These findings, therefore, indicate that the Khelo India program has had success in fulfilling its intended purpose of increasing the number of athletes that participate in the Khelo India Games, but has yet to exhibit success in creating outcomes in relation to the development of athletes from the various states of India. However, such a failure to develop athletes may be intentional of the organization, as the 2024 IISM report states that the construction of sports infrastructure within India is a long-term investment that will eventually pay for itself in terms of the increasing number of athletes from India that compete successfully in international competitions. Furthermore, such a three-year evaluation period for the Khelo India program may be insufficient to evaluate such outcomes regarding the development of athletes of the nation.

For these reasons, the future of the Khelo India programme should shift from construction of sports infrastructure to improvements in the other factors that impact the success of athletes of India that compete in the nation's youth games. Instead of focusing on the construction of infrastructure or stadiums for the athletes of India, the Khelo India programme should consider directing most of its efforts into improving the coaching of athletes, the implementation of competitions between athletes, and the development of sports science programmes that work with those athletes to develop their athletic skills. India has already succeeded in encouraging the participation of athletes from states with few athletes in national competitions to participate in the Khelo India Games. Now, the effort of the programme should shift to ensuring that those athletes of India are developed to compete at high levels within the nation's competitions.

Limitations

There are several limitations of the study that should be considered.

The first limitation of the study is that the sample size is small ($n = 36$ states and union territories). Small sample sizes tend to have less statistical power to demonstrate statistically significant relationships between variables. For instance, the study found that the relationship between funding and the number of medals won approached statistical significance ($p = .069$ with Gujarat excluded), and with a larger sample of states and union territories, such a relationship may well have proven statistically significant. Furthermore, there are only 36 states and union territories within India, so the sample size cannot be increased without changing the level of analysis to a smaller geographic region within the country, such as the district level.

Second, some of the relationships that were analysed were sensitive to the inclusion of the state of Gujarat, an extreme outlier on Cook's Distance across all three analyses that used funding as a variable. Specifically, funding had a significant relationship with the total number of participants ($p = .015$) and the conversion rate ($p = .037$), but not with the number of medals won, whether Gujarat was included ($p = .619$) or excluded ($p = .069$). It is possible that funding relates to participation and conversion rate, but not

to medals won, because another variable related to athletes' success, such as coaching and training facilities, plays a more direct role in determining medal outcomes. This pattern, where funding relates to two variables but not to medals won, points to a potential limitation of this kind of analysis, especially with such a small data sample: the conclusions drawn are sensitive to the inclusion or exclusion of just a few data points, which should be considered when performing similar analyses with equally small samples.

Third, statistical significance does not necessarily imply practical significance. Though the funding model's results are statistically significant in relation to both athlete participation ($R^2 = 0.167$) and conversion rate ($R^2 = 0.125$), each of these figures indicates that only a modest portion of the variation in these variables is accounted for by funding. The remainder of the variation in both is driven by factors outside the model. Thus, while funding is associated with participation and conversion rate, it is not the primary factor behind these outcomes.

Fourth, although the LLM-assisted digitization of the records from Khelo India is discussed in Section 3, only a small sample of those records has been manually cross-checked for potential errors in data entry. A larger sample of the digitized records could have been cross-checked to ensure the accuracy of the digitization process, especially given the potential effect that such errors could have on the results of a relatively small sample of this kind.

Finally, despite the thorough manner in which the data were analysed, this study remains correlational and cross-sectional in nature, and thus cannot establish causal claims about what "works" to improve sporting outcomes across Indian states. The outcome variables may have been influenced by other, unmeasured factors altogether, and these relationships should therefore be understood only as associations observed within these specific editions of the Games.

CONCLUSION

This research study aimed to investigate whether there was a significant relationship between the investment made into the development of sports infrastructure by Khelo India and the sporting performance of youth athletes across Indian states. The findings of the research revealed that while there was a positive relationship between the two variables, the correlation was weak. Furthermore, the states that appeared to have made the most efficient use of the infrastructure investments were those that already featured well-developed sporting ecosystems before the implementation of the Khelo India programme. These results indicate that while the sports infrastructure investment by the Khelo India program is one of the foundations upon which the sporting development of youth athletes in India exists, the structure that is built upon that foundation varies significantly from state to state.

While the infrastructure and financial investments are the prerequisites for sporting success for youth athletes of India, the critical variable in determining whether those athletes succeed is human capital, which includes coaching quality, institutional support, and competition exposure. The effect of the

host-state present in all three editions of KIYG illustrates the importance of logistical and contextual factors on athlete performance, independent of the effects of long-term infrastructure development. For the program to fulfil its goal of expanding India's sporting base beyond its dominant states, the program must invest in the human capital and institutions that can develop these athletes once the facilities are constructed. As the IISM (2024) report states, the right infrastructure at the right time helps in developing athletes immensely; however, these findings suggest that focusing on providing athletes with the right coaching, the right competitions, and the right institutional support is just as important as investing in infrastructure.

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