Research Journal for Societal Issues

Vol 5 No 1 (2023): 417-433

Socio-Economic Determinants of Sports Performance: An Empirical Investigation among the Countries of the World

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Keywords: *GDP, Sports, Socio-Economic*

Article History

Date of Submission: 24-02-2023

Date of Acceptance: 30-03-2023

Date of Publication: 31-03-2023

DOI No: 10.56976/rjsi.v5i1.157

The present study has explored socioeconomic determinants of sports performance among the world's countries. The countries' sports performance has been measured using the total number of gold, silver, and bronze medals. The weights of gold, silver, and bronze medals have been assigned 4, 2, and 1, respectively. Gross domestic product (GDP) per capita, health, education, and population determine sports performance. The education and health index proposed by the United Nations Development Program (UNDP) has been used as a proxy for education and health. The influence of regions was captured by using dummy variables. Balanced panel data of 113 countries that participated in all Olympic events from 1972 to 2022 with four-year intervals have been used. However, a separate empirical analysis has been made for 80 countries that attained at least one gold, silver, or bronze medal from 1972 to 2022. Three econometric models have been estimated for each case by applying a fixed and random effect approach. Hausman test has been applied to identify the appropriation of fixed effect and random effect models. Using descriptive statistics, we have found that GDP per capita, education, health, and population are positively and significantly associated with sports performance. Results of dummy variables indicate that the European region has better sports performance than Asia, Australia, America, and Africa. Improvement in GDP per capita, education, and health has been suggested as a strategy to improve sports performance.

1. Introduction

Physical activities are essential in human resource development among the countries and within a country. Usually, a substantial body has a strong mind. Involvement in physical activities reduces crimes and other social evils. Finding determinants of sports performance across individuals and countries is essential. Sports performance within a country and among the nations can be determined by several factors like expenditures on sports and environment, which is observed from the norms and culture of a society. Other elements, such as living standards and social conditions, are essential in deciding on sports performance. Public provision of facilities in different games improves the performance of players. Training of players and natural ability are necessary at the micro level, and government expenditures on sports, provision of health facilities, educational facilities, political stability, and foreign policy are required at the macro level (Bosscher et al., 2006). Some research conducted internationally to identify factors that affect sports performance focuses on resource endowments, a country's population, and cultural and social resources (Fahlevi et al., 2023; Yeniyurt & Townsend, 2023; Kiviaho & Makela, 1978; Bernard & Busse, 2004; Andreff, 2001; Johnson & Ali, 2004). It is suggested that prosperous countries in sports have abundant financial resources, a large population, and an appropriate climate. The studies indicate that countries such as the United States, Great Britain, and Australia have an advantage in sports competitions due to their economic endowments.

On the other hand, some less developed countries have comparatively better performances in specific games, like Ethiopia in running, Angola in basketball, and Cameroon in football. However, statistics from the Olympics indicate that from 1896 to 2022, the top five countries also had better economic performance. Like the United States (US), China, Russia, the United Kingdom (UK), and Germany. This postulates that the socioeconomic condition of an individual, country, and region is significant in determining sports performance (Yeniyurt &Townsend,2023)

Physical activities are directly related to resource endowments, a country's population, and social resources (Kiviaho & Makela, 1978; Andreff, 2001; Johnson & Ali, 2004). The competitive environment positively impacts sports activities, which helps increase physical activity in different regions (Rahimitabar et al.,2023; Kerketta, 2015). "Competition is a social process that occurs when reward is given to people based on their performance as compared to the performance of others doing the same task or participating in the same event" (Coakley, 1994). Improvement in sports performance through competition reduces anxiety among the players. "Anxiety is a negative emotional state in which feeling of nervousness, worry, and apprehension is associated with activation or arousal of the body." (Weinberg & Gould, 2007). The players who perform at the international level have lower anxiety than those who participate in domestic competitions (Simon & Martens, 1977). At the same time, some socioeconomic and psychological factors are also essential to enhance the degree of performance among the players in different regions (Chandrasekaran et al., 2010; Feng & Shi,2022). The economic status of football and Kabaddi Players has a more significant impact on their performance than social status. Students of low

socioeconomic status have low participation, and high socioeconomic status have high participation in physical activities (Elmagd, 2016; Al-Matari et al.,2022). Luiz and Fadal (2010) have explored the significance of GDP, education, and health in enhancing sports activities in South Africa. A country's share in the Olympic medals is almost equal to the share of the country's GDP to the world's total GDP. Host countries performed almost 2% more in the Olympics (Bernard & Busse, 2000). Sports also contribute to a country's economic success by enhancing its GDP and other socioeconomic factors (Jhais et al., 2014). Population and income per capita have a similar role in enhancing the medals in the Olympic events (Bernard & Busse, 2004). Demographics, culture, and climate are essential determinants of sports performance (Hoffmann et al., 2002; Yang et al., 2020). Some other socioeconomic factors like educational outcomes, health outcomes, a region's population size, regions, and environmental factors such as climate change, pollution, etc., and economic activity may also be important determinants of sports performance at the macro level.

The present study has investigated some socioeconomic determinants of sports performance among the countries of the world by using panel data. The countries' Sports performance have been measured using the total number of gold, silver, and bronze medals. The weights of gold, silver, and bronze medals have been assigned 4, 2, and 1, respectively. Gross domestic product (GDP) per capita, health outcomes, educational outcomes, and population are considered determinants of sports performance. The influence of different regions (Asia, Europe, America, Australia, and Africa) has been captured using dummy variables. Balanced panel data of 113 countries that participated in all Olympic events from 1972 to 2022 with four-year intervals have been used. However, a separate empirical analysis has been made for 95 countries that attained at least one gold, silver, or bronze medal from 1972 to 2022. Three econometric models have been estimated for each case by applying fixed and random effect approaches. Hausman test has been applied to identify the appropriation of fixed effect and random effect models.

2. Literature Review

There is a vast literature on physical activities and the health of individuals. Some studies are relevant to the connection between sports activities and health. However, studies about determinants of sports performance have yet to be available. The elements like GDP, population, and health achievement are examined in many studies. Different researchers used different statistical techniques. Results showed that socioeconomic variables depicted a positive impact on sports performances (Yang et al., 2023; Feng & Shi, 2022; Kiviaho & Makela, 1978; Baimbridge, 1998; Condon et al., 1999; Tcha & Pershin, 2003; Kuper & Sterken, 2001; Hoffmann, 2002; Ging & Ramasamy, 2004; Bernard & Busse, 2004; Matros & Namoro, 2004; Johnson & Ali, 2004). Different researchers investigated the elements that affected sports performances. Some authors tried to expand on the methodology of the former studies by applying weighted medal totals, adapted regression analysis, and comprising White-corrected errors to account for heteroscedasticity. Olympic medal counts were used as a dependent variable to represent Olympic achievement and socioeconomic variables were used as independent variables. Two

macroeconomic variables, GDP and population, were constantly associated with sports performances. Findings significantly positively impact sports performances (Condon et al., 1999; Tcha & Pershin, 2003; Bernard & Busse, 2004). Some studies explored determinants of sports performance at the macro level. A review of those studies has been reported in this chapter.

Bernard & Busse (2000) determined the relationship between the share of medals won in the Olympic Games and the GDP of different countries. Data had been taken from 1960 to 1996 from different countries. They used graphical patterns of income and medal winning in analysis. They found that two nations with massive differences in population had an almost equal share of medals at the Olympic Games. Findings showed that the host country won 1.5 more than their GDP share. In addition, Bernard and Busse (2004) determined that the population and GDP per capita played a similar role in sports performance. Data used from the period 1960 to 1996. Results showed that many factors affect the chances of winning in Olympic events. An increase in per capita income maximized the medal-winning chances. Host countries are likely to win 1.8% more medals than their GDP share. Findings also expressed that Athlete's performances belonging to their natural talent played an essential role in their performances. The study also asked, "Why does China win only 6% of the medals even though it has 5th of the world's population?". In their study, they addressed these kinds of questions.

Andreff (2006) studied how total GDP and GDP per capita were essential factors for achievements in international sports. Findings showed that total GDP is the best forecaster of national Olympic performance than GDP per capita. The model was used to forecast the number of medals gained by Australia in 2000. It suggested that if the government should mobilize the economic factors, it will escalate the gap between the sports performances of the developed and underdeveloped countries. Ahmadi et al. (2010) investigated the relationship between the number of countries' medals and other socioeconomic indicators like health. This study regressed the total medals on population, adult population, health expenditure, and GDP. Poisson nonlinear regression was used to determine the results. Findings showed a positive impact on the adult population than other fractions of the population. Those countries that spent more share of GDP on health to increase sports performance showed significantly better results than others that were less concerned about increasing the health sector. Andreff et al. (2008) found the effects of GDP, population, political regime, and event hosting on sports performances. Hoffmann et al. (2002) identified the country's performances in international Soccer games. In this paper, temperature is used as the average temperature per year. The exciting thing in this paper is that demographic and geographic situations affect sports performance. Findings depicted a significant positive relationship between Latin culture and population size on sports performance, while both variables showed insignificant relation with sports performances when these were used individually. Per capita income positively impacted sports performance.

Fadal (2010) expressed the relationship between socioeconomic variables, urbanization, polity, human behavior, and sports performances. This study identified the specific factors that increased success in sports performances using cross-sectional data in African countries. They determined African countries' sports performances, considering various socioeconomic factors.

This study used four models to investigate the effects of education, health, climate, GDP, population, and corruption. They found that GDP depicted a positive and significant impact on sports performances. Most studies found that population and GDP were positively linked to the number of Olympic medals granted. The current study mostly confirms these former results. These forecasts were very parallel to the fundamental values and thus helped as a test of the statistical robustness of the models estimated in this study. Xun Bian (2005) studied the relationship between a country's Olympic achievements and its overall economic situation, including population, economic assets, and political organizations. A panel data set involving the yearly data of 1996, 2000, and 2004 was assessed by using a fixed-effect Tobit regression model. Findings indicated no significance among the urban population and number of medal gains, but other variables were significant. A positive significant association between health and GDP was found. More adult population also yields more good athletes and, therefore, a reason to win more medals. Mosa and Smith (2004) investigated the determinants of player's performance in the Olympic games in Sydney 2000.

Previous studies identified the importance of economic size for sports performance. This paper examined the impact of health expenditures on sports performance. Findings showed that several athletes and national expenditures on health had a significant effect on sports performances. Andreff made three estimations to examine the impact of these variables on sports performance. Firstly, they showed the nexus between sports performance and socioeconomic variables (Bernard & Busse, 2004). A second description increased variables that captured cultural changes across several areas in the world. Lastly, about the forecast of the would-be medal wins in Peking 2008, an inertial variable presented in the macroeconomic model to capture an 'Olympic worship' in those countries used to win a sum of medals. A variable separated them from other contributing nations. Lattipongpun (2010) examined the beginning of the Olympic Games presentation of the opening and closing ceremonies important for host countries, culture, and costumes shown to the world.

Descriptive analysis is used for the determination of results. He used two words for the Olympic Games' opening and closing ceremonies: "celebratory atmosphere." Studies showed that the Berlin and Tokyo games significantly used opening and closing ceremonies as a tool for public relationships. Results showed that opening and closing ceremonies positively impacted the sports performances of these nations. Chandrasekaran et al. (2010) explored the relationship between playing talent in different performers of state-level football players and socioeconomic position and psychological factors. He took a sample consisting of 150 football players between the ages of 18 and 25. The sample is divided into three groups of 50 players. He used socioeconomic status, anxiety, and aggression. ANOVA technique was used to examine the relationship. Results showed the significant effect of socioeconomic and psychological factors on player's ability to perform the game at low and high-level football players. Edds (2012) found that the Loss Angles 1998 Olympic games were financially profitable. He used the current economic cost and benefits analysis. In this study, he compared the host country with another that does not host Olympic events by examining infrastructure, general growth, and development over nine years. Putt (2013) investigated that the

summer Olympic Games always accelerate great interest and subsequent comments from national media and administrators, which depicted the performance of the country and the morale of their public to boost the sports spirit in the respective country. This performance is based on the gold medal comparison among the different countries. It showed the achievements of the developed countries and the extraordinary achievements of smaller countries. The findings indicated that the Olympic performances were highly based on their population size.

Some researchers who studied individual games, like observed that Kabaddi and Football players did not differ significantly concerning their social status but significantly concerning their economic and socioeconomic status. He used a sample of 60 with 30 Kabaddi players and 30 from soccer and got the results by using variance analysis for the data. Singh (2014) studied the difference between hockey and cricket players in Jammu and Kashmir. They used a sample of 50 hockey players and 50 cricket players, cricket players, representing at least once at state-level competition. For this purpose, he used the interview technique for collecting data. Results showed that there was no significant difference between hockey and cricket players.

Inder & Kerketta (2015) examined the comparison between the sports competition anxiety between male soccer and volleyball players. He took a sample of 60 males, 30 from soccer and 30 from 18 to 25 years of volleyball. He developed a questionnaire for collecting data. Findings showed no significant difference between the players of both games in their sports competition anxiety. Sharma (2015) investigated the effects of socioeconomic status on junior national-level weight lifters' sports performances in rural and urban areas of India. A sample of 200 male weight lifters (100 from urban and 100 from rural) was taken. Data was collected via a questionnaire. Descriptive analysis was used for the results. Findings depicted the positive impact of socioeconomic variables on the sport performance of weight lifters. The difference between high, mediocre, and low socioeconomic status affects sports performance. Players who possessed high socioeconomic status performed better against players than the players who possessed low socioeconomic status.

Mugari & Bukalia (2016) aimed to measure and determine the welfare of farmers due to sports activities. Two samples, A1 and A2, were taken based on sports activities. The basic concern of this study is to determine the reasons behind the traditional opinion of farmers to give their whole energy and time to grow farms and the passive approach of farmers to participate in sports. Some farmers spend all their time on farms and do not participate in sports activities. They believe that time spent in sports wastes precious time, while researchers found that "sports exercise is medicine." Findings showed that most farmers were renowned for the social welfare of being sport-active but were ignorant of the economic benefits. Gp and Martin (2016) studied the socioeconomic status of Karnataka state's volleyball players. Chi-square and Cramer's v test were used as a statistical technique to check the relation between volleyball players' socioeconomic status in different tournaments. A sample of 60 students from different universities was collected. Results showed that 71.7% belong to the middle class, 15% belong to the lower and 13.3% belong to the high socioeconomic status. Mukherjee et al.(2016) determined the skill-related fitness between residential and nonresidential school boys. They used the test to check the significance

level at 0.05%. Data was collected from three Indian schools for students aged 14 to 17. The sample comprised 60 students, 30 from residential and 30 nonresidential boys. Experimental activity to throw a shuttle at 50 yards in seconds. Findings showed that the residential and nonresidential boys showed no significant difference in agility. A significant positive relationship was found between agility and their powers.

Elmagd et al. (2016) determined to check the social and economic status and participation in physical activities. Descriptive technique used to determine the results. There are many variables used in this study. Results depicted a significant positive correlation between the mother's education and the student's physical activities, while the father's education and physical activities were uncorrelated. A significant negative correlation was found between the number of family members and physical activities. The majority of the students belong to medium socioeconomic status. The students with high socioeconomic status had high performance in physical activities, and those with low socioeconomic status had low performance in physical activities. Celik and Guis (2014) investigated that many previous studies attempted to determine the causes of Olympic medals won. Some other studies conducted at the macro level are discussed. In each study, independent variables were correlated to sports performance. Most of the studies used simple correlations or regression analysis. During the last decade, some authors have tried to improve the methodology of these studies (Fahlevi et at., 2023; Yeniyurt & Townsend, 2023; Baimbridge, 1998; Bernard & Busse, 2000; De Bosscher et al., 2003; De Koning & Olieman, 1996; Den et al., 1995; Johnson & Ali, 2002; Tcha & Perchin, 2003). There is an equal distribution of sporting talent throughout the world. Every nation has equal opportunities to produce competitive elite athletes (Grimes et al., 1974; Levine, 1974; Kiviaho & Mäkelä, 1978; Morton, 2002). Many studies showed the distribution of talent argument and highlight the influence of two independent macro-economic variables: Gross National Product (per capita) of a nation and its population (Bernard & Busse, 2000; De Bosscher, De Knop & Heyndels, 2003; Jokl, 1964; Johnson & Ali, 2002; Kiviaho & Mäkelä, 1978; Levine, 1974; Morton, 2002; Novikov & Maximenko, 1972; Suen, 1992; Van Bottenburg, 2000). These two variables consistently explain over 50% of the total variance of international sporting success. The present study is going to explore some other factors that are also important for sports performance, such as education, health, and natural climate. We are testing the impact of different regions on the sport's success.

3. Theoretical Framework and Methodology

3.1 Theoretical Framework

The population is an essential factor that affects sports performance. The population had a positive impact on sports performance. We have conceived from previous studies that the large population countries have more advantage in the Olympic Games. Bernard & Busse (2000 and 2004) found a positive relationship between sports performance and population. Graem D Put's (2013) study also complied with the previous views about the population and sports performance. He said that the Olympics is all about population. Sports performances have yet to be explicitly studied in theories. We do not find a theory about sports performance. Sports efficiencies are called sports performances. Previous studies used soccer ranking (Hoff Mann, 2002), weight lifters

performances (R K Sharma, 2015), and Olympic medals (Bernard & Busse, 2000; Bernard & Busse, 2004; Duran P, 1992). This study used Olympic medals as a proxy for sports performance. Mosa and Smith (2004) investigated how health significantly impacted economic development and sports performances. The countries with more expenditure on health have a significant share of medals winning probability in the Olympics. In modern days' sports become an industry. It boosts the economic development. In earlier studies, we observed the impact of population on medal attainments in the Olympics. The adult, rural, and total populations are used as proxies for the population (Ahmadi et al., 2010). He found that gross domestic product played a significant role in economic performance among countries. No significant relationship exists between the numbers of medals a country gains and its total population. However, the adult population significantly impacts medal gaining in the Olympic Games. Bernard & Busse (2000) found that the countries with massive differences in population but the same GDP have an equal share of medals won in the Olympic Games. No study has been found that mainly addresses education's impact on sports performance.

In this study, we have used proxies of the variables such as education index (EI) for education, Health index (HI) for health, per capita GDP expenditure for GDP, Total population (POP) for population, and Medals won in the Olympics games is used as a proxy for sports performance. We used medals won in the Olympic Games from 1972 to 2022.

3.2 Methodology

In this study, we have used panel data from 1972 to 2022 from different countries participating in the 1972 Olympic Games. A total of 113 countries participated in the 1972 Olympic Games. Other data sets from 80 countries have been used. Those won at least a medal in Brazil's Rio Olympics games in 2022. We have used RE and FE in the panel data study to determine the results. Many econometrics showed that empirics found displayed through OLS and then fixed effect and Random effect in panel data allowed to decrease the omitted variable bias. In different countries, analysis compensated the time-invariant differences in these characteristics unobserved in a cross country. The use of explanatory variables is an attempt to measure the unobserved characteristics of the country. The panel data estimation techniques RE and FE do not check the time-variant variables and omitted variables unobserved factors involved, such as tariff government regulation, corruption and culture, and people abilities regarding human capital.

Many econometrics books suggested the results of OLS along with RE and FE (Forbes, 2000). OLS first just an approximation and random effect (RE) and fixed effect (FE) sufficient depiction of analysis.

4. Analysis

4.1 Econometric Form of Models for the Countries Participated in the Olympic Games

We have used three models for the countries participating in the Olympic Games since 1972. We used sports performances as dependent variables and socio-economic variables as independent variables. Dummy variables are also used for different regions. We used five dummy

variables for five continents. These are taken concerning the Olympic Games symbol. The five rings represent the five different regions.

4.2 Model 1

SP = f (GDP, EI, HI, POP, d2, d3, d4, d5)

In the above model, we have expressed the relationship between Sports performance, health index, and education index. Many other factors may affect Sports performances, reasonably affecting GDP and population. To consider reasonable control variables being chosen on the base of essentially witness by empirics. In the data collection process, many variables are collected for study. Many variables are excluded in the model specification process, so we took our final model. We mainly choose the final model variable rather than considering excluding other variables. In model 1, we consider checking the effect of sub-indices of the HDI health and education indexes. In which health index and education index are used instead of HDI, and control variables use population and Gross domestic product. Dummy variables are used for the regions.

Table No 1: Description and Construction of Variables Used in This Study (Variable Description)

Variable	Abbreviation	Description	Source
Sports Performances	logSP	Log of medals won in olympic games is used as an indicator of sports performances. A score is given to medals as 4:2:1 to Gold, silver and bronze medal respectively.	Official website of International Olympics Games
Education Index	LogEI	Log of education index a measure to check education for development	UNDP
Health Index	LogHI	Log of health index a measure to check health for development	UNDP
Gross Domestic Product	LogGDP	Log of Gross domestic product to check per capita income of a country	WDI
Population	LogPOP	Log of population measure as the population	WDI
Dummy Used for Europe	d_1	Dummy d_1 is used for the countries of Europe (Represents by blue ring of olympic symbol)	World information
Dummy Used for Asia	d_2	Dummy d_2 is used for the countries of Asia (Represents by yellow ring of olympic symbol)	World information
Dummy Used for Australia	d_3	Dummy d_3 is used for the countries of Australia (Represents by green ring of olympic symbol)	World information
Dummy Used for America	d_4	Dummy d_4 is used for the countries of America (Represents by red ring of olympic symbol)	World information
Dummy Used for Africa	d_5	Dummy d_5 is used for the countries of Africa (Represents by black ring of olympic symbol)	World information

4.3 Data Source

The data for this study consists of two main components: Olympic medal counts and socioeconomic indicators. Regarding socioeconomic indicators, we would ideally like to have a choice of indicators, including population, GDP per capita income, health index, and education index. However, there is difficulty in gaining such measures for the total 113 countries participating in the Olympic Games in 1972 and 80 countries who won at least a medal in the Olympic Games from 1972 to 2022.

4.4 Empirical Results and Discussions

The impact of socioeconomic variables on sports performances has been determined, and results have been reported in this chapter. In the first section, we discuss descriptive statistics and then move toward the correlation between the variables for both cases. Lastly, we discussed the empirical results of the model in each case.

4.4.1 Data Analysis for Countries Participated in the Olympics

In this section of the chapter, we first check the descriptive statistics of data, then the correlation between the variables, and lastly, we discuss the empirical results of the models.

4.4.2 Descriptive Statistics

Descriptive statistics depict the quantitative description of the data's main feature used in our study. This included the mean, maximum, and minimum observation values, standard deviation, and total number of observations used in the study.

Table 2 Descriptive Statistics Dependent Variable: Sport Performance

Variables	Observations	Mean	Std. Dev.	Min	Max
logSP	1356	14.9727	44.7278	0.00	484
LogGDP	1344	8.77193	1.23633	5.15564	11.4724
LogPOP	1344	16.094	1.68848	9.22276	21.0239
LogHI	1332	-0.3091	0.4478	-1.5861	9.57571
LogEI	1344	-0.0279	1.877434	-3.1735	11.2762

The total number of observations of sports performances is 1356, the average value is 14.9727, and its standard deviation is 44.7278. The maximum value of sports performance is 484, and the minimum value is zero, which shows the vast difference between the high and low values of sports performances. Standard deviation also shows the diversity of the sports performances. The number of gross domestic product observations is 1344; The average log value is 8.77193, and the standard deviation is 1.23633; gross domestic product ranges from 11.4724 to 5.15564, which expresses the difference in gross domestic product in sampled countries. The average value of the log population variable is 16.094, the standard deviation is 1.68848, the maximum value is 21.0239, and the minimum value is 9.22276. The population has 1344 numbers of observations.

The average log value of the health index is -0.3091, and the standard deviation is 0.4478, with a maximum value of 9.57571 and a minimum value of -1.5861, which indicates the difference between the maximum and minimum values of sampled health index data. The health index has 1332 numbers of observations. The average log value of the education index is -0.0279, with a standard deviation of 1.877434, a maximum value of 11.2762, and a minimum value of -3.1735, which shows the high range difference in data. Education has 1344 observations.

4.4.3 Correlation Analysis

In this case, we take sports performances as dependent variables and population, gross domestic product, health index, and education index as independent variables.

Table No 3: Correlation Matrix Dependent Variable: Sport Performance

Variables	logSP	LogPOP	logGDP	LogHI	logEI
logSP	1				
LogPOP	0.2024	1			
LogGDP	0.2253	-0.258	1		
LogHI	0.2255	-0.199	0.8078	1	
LogEI	0.262	-0.1895	0.6442	0.7924	1

The correlation matrix depicts that sports performances positively correlate with population 0.2024; although the correlation is shallow, the positive relationship is expressed in theories and empirical. Sports performances are also positively related to a GDP value of 0.2253, slightly more than the population. Sports performances also correlated with health and education index values of 0.2255 and 0.262, respectively. Correlations are found between dependent variables and explanatory variables. Although a strong association has not been found, the relationship carries weight to further empirics, showing the connection from a broader perspective. Results show that the correlation is higher in sports performances and education index. A percent change in the education index increases 26.2% in sports performances, one percent change in the health index increases 22.55%, one percent increase in GDP per capita rises 22.53% in sports performances, and one percent increase in population enhances 20.24% in medals win in international Olympics games.

A correlation is also found between the explanatory variables as the population has negatively correlated with the rest of all the explanatory variables used in the model. The result shows that a one percent increase in population decreased the GDP up to 25.8 percent, decreased the health index by 19.9%, and decreased the education index by 18.95%. GDP has a high positive correlation with the health index and education index. GDP correlates with hi and EI as 0.8078 and 0.6442, respectively. A correlation is also found between the education index and the health index. Both have a positive correlation with each other. A percent change in health caused a 79.24 percent increase in education. As we read in theories, health affects education.

4.4.4 Panel Regression Estimates

To check the impact of health and education simultaneously, we used a model with d1 as a reference dummy. The second model deals only with health, and the last model tells us about the impact of education on sports performance. Our study determines the relationship between sports performance and socio-economic variables. We take 113 countries and 45-year data with 12 points of time of almost all countries participating in the Munich Olympic Games in 1972. Education measures using the proxy Education index, Health measures using the Health index, population measures using the proxy total population, Economic growth measures using proxy GDP per capita, and the medals measure Sports performances won in the Summer Olympic games. All variables are taken as log values except dummy variables. Sports performances are affected by regions, so dummy variables are used for the continents. The Olympic rings show five different continents of the world, so we used *d1* for Europe, *d2* for Asia, *d3* for Australia, *d4* for America, and *d5* for Africa.

4.4.5 Model 1

This model evaluates the relationship between sports performances, Gross domestic product, Population, Health index, and Education index. Different studies show unspecified findings on the relationship between sports performance and socio-economic variables. Hosting and Olympic events were not in favor of increasing the gross domestic product of the host country than the runner-up, while the other study, "The Olympic effect," presented that the host country has long-term benefits on GDP (Spiegel, 2014).

Table 4.3: Sports Performances and Socio-Economic Variables (Dependent Variable: Sports Performance)

logSP	**OLS**		**RE**	
	Coefficient	Probability	Coefficient	Probability
logGDP	0.26488	-0.012	0.26488	-0.012
logPOP	0.34625	0.000	0.34625	0.000
logHI	0.4353	-0.533	0.4353	-0.533
logEI	0.51204	-0.122	0.51204	-0.122
d2	-0.9222	-0.001	-0.9222	-0.001
d3	0.43854	-0.455	0.43854	-0.455
d4	-0.8631	-0.003	-0.8631	-0.003
d5	-0.6508	-0.069	-0.6508	-0.069
Constant	-5.36	-0.001	-6.0108	0.000
Diagnostic Tests of the Model				
Hausman	0.2060	**Auto Correlation**	0.000	
Hetro	(0.0000)	**Ramsey Test**	(0.000)	
Endog	0.00083	**Anderson**	0.000	
Cragg	21.58	**Sargan**	0.001	

Socio-economic variables affect sports performances (Luiz & Fadal, 2010; Kiviaho & Makela,1978; Andreff, 2001; Johnson & Ali, 2004). Hosting an Olympic Event is profitable for the host country (Samantha Edds,2012). The analysis is carried out through OLS, Random effect. The relation between Sports performance, Gross domestic product, Health index, Education index, and Population is estimated. The impact of Population and Gross Domestic Product is significant on Sports performances. However, the coefficient sign of Population is positive in OLS and the Random effect model. The coefficient shows that a 1% increase in Population enhances 34% of Sports performances. This means the increase in Population enhances the chances of medals being won in the Olympic Games. Results supported by literature (Bernard & Busse, 2000 and 2002; Luiz & Fadal, 2010; Andreff, 2006; Shughart & Tollison, 1993; Poupaux, 2003). Europe is taken as a reference dummy (*d1*). Results show that Europe is better at sports than other continents.

Diagnostics results have shown a problem of heteroscedasticity and serial correlation, as the p-value shows. The Sargan test is applied to find out the over-identification test; this test indicates that the instruments used in the study are appropriate and not linked with the error term. The P-value 0.000 of the Sargan test elaborates that the model needs to be more over-identified. Cragg-Donald's (1993) test is performed to determine the weak identification. The F statistic 21.58 elaborates that the model is not identified. The P-value of 0.000 of the Anderson canon test depicts that the matrix of reduced form coefficients needs to be identified.

5. Conclusion and Policy Implication

This study examined the consequences of socioeconomic variables in the context of sports performances. The education and health indexes are used as a proxy for human development. Empirical findings were reported using panel data, and countries were taken as sections. Analysis was made on two types of data. The countries that participated in the Olympic games, and a second set of data covers the countries that won at least one medal from 1972 to 2022. The first analysis consists of one hundred and thirteen countries with thirteen hundred and fifty-six observations. The second set consists of nine hundred and sixty words. Comments were comprised of eighty countries and 45 years. Sports performance is taken as a dependent variable.

The results of the first model expressed that the first hypothesis stated gross domestic product did not affect sports performances. It was rejected against the alternative view. In the second model, nullifying the theory said that the health index did not affect sports performances. It was also dismissed against the alternative hypothesis health affected sports performance. The third hypothesis indicated that the education index did not affect sports performance. The fourth hypothesis suggested that the population did not affect sports performances. It was negated by showing that sports performances affected people expressively. The last idea was that different regions did not affect sports performances and was rejected for the alternative hypothesis.

Empirical results indicated that all null hypotheses were rejected for the worldwide panel in sampled 80 countries having a minimum of a medal in Olympic history, and 113 countries

participated in the Olympics. Findings indicate that GDP, health index, education index, and population have a positive and significant relationship with sports performances. This shows that economic activity, education, health, and folk are essential determinants of sports performance differences among the world's countries. Countries with high GDP per capita have better health performance and higher education levels and may have better performance in sports. On the other hand, the results of the dummy variables indicate that the European region has better sports performance than Asia, Australia, America, and Africa. Parts are essential to the sport's success due to their natural environment. Every region of the world has its own identity and climate. Improving GDP per capita by enhancing economic activity in a country can improve sports performance at the macro level. Similarly, public provision of social services related to education and health may promote sports performance. Increasing socioeconomic development is a valuable strategy to enhance sports performance, especially for countries with lower GDP per capita, lower educational outcomes, and poor health.

6. References

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