Queens over Kings: Gender and Socioeconomic Predictors of Competitive Chess Performance among Peruvian Youth

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Abstract

The aim of this research is to determine whether socioeconomic factors can predict the chess performance of young Peruvian players, measured as the probability of winning a medal (first, second, or third place) in a championship. To achieve this, we explore data from the "National Survey of Youth Chess Players participating in the 2021 Pan Floripa", conducted by the Peruvian Chess Sports Federation (FDPA) after the XXXI Pan American Youth Hybrid Festival 2021 (Pan Floripa 2021). To predict the probability of winning a medal, a binary regression model is estimated using maximum likelihood methodology, assuming a logistic probability distribution. The results indicate that facctors such as gender, previous performance, age, internet access quality, having siblings, and academic performance are significant in predicting a player's likelihood of winning a medal in a chess competition. While the estimated coefficients may not necessarily represent causal effects, the analysis suggests that the probability of a female player winning a medal is higher than that of a male player by at least 26 percentage points. Oaxaca-Blinder and Ñopo decompositions confirm the significant impact of gender on chess performance. To the best of our knowledge, this is the first scientific research on the performance of young Peruvian chess players; furthermore, its findings can be valuable for identifying players with a high probability of winning in championships and for designing strategies aimed at enhancing the performance of chess players.

Keywords	:	Chess performance, socioeconomic factors, logit, youth players, gender differences.
JEL Classification	:	C25, J13, J16, Z20

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1 Introduction

Chess is a popular sport that has experienced a surge in interest since the pandemic, driven by the rise of online recreational activities, the global success of the Netflix series The Queen's Gambit, and the increasing accessibility of digital platforms for learning and playing (Lahood, 2021). Beyond its entertainment value, chess is recognized for its cognitive and professional benefits, positioning it as a subject of growing academic and societal significance.

Recently, the connection between chess excellence and professional success gained prominence with the awarding of the 2024 Nobel Prize in Chemistry to Demis Hassabis, co-founder of DeepMind. Hassabis's early engagement in competitive chess, achieving master-level proficiency by age 13, underscores the potential long-term cognitive and strategic benefits that chess can offer to young players (Friedel, 2024). His transition from chess prodigy to groundbreaking AI researcher illustrates how foundational chess skills - such as problem-solving, critical thinking, and decision-making - can translate effectively into other intellectually demanding fields. Hassabis's case further emphasizes the importance of identifying and nurturing chess talent early, reinforcing the relevance of examining socioeconomic determinants that influence young players' chess performance.

Academically, chess has been extensively studied, especially in the fields of psychology (i.e. De Bruin et al., 2008) and education (for a recent meta-analysis, see Sala and Gobet, 2016), due to its potential benefits in improving academic performance and intelligence. A key area of research focuses on the study of factors that explain or predict a chess player's performance and success, often measured by rankings or medal achievements in competitions. Studies suggest that variables such as gender, age, cognitive ability, psychological factors, training, and environmental factors help to predict chess performance (i.e. Backus et al., 2016, 2022; Blanch et al., 2015; De Bruin et al., 2014). Given that chess is an intellectual sport highly correlated with intellectual capacity (Burgoyne et al., 2018), it is reasonable to expect that some variables determining academic performance may also predict chess performance.

Peru is home to a pool of talented chess players.[1] The country has established itself as a chess powerhouse at the school level (Olmo, 2022), with young players consistently securing international titles and medals in South American, Pan American, and World Championships .[2] However, many of these achievements occur despite significant economic challenges faced by families supporting their children's chess careers (Olmo, 2022). This contrast between talent and financial constraints underscores the importance of investigating the socioeconomic factors that shape chess success, particularly

[1]According to the International Chess Federation (FIDE) ranking, currently, the best Peruvian players are Julio Granda (ranked 136th, `https://ratings.fide.com/profile/3800024`) and Jorge Cori (ranked 244th, `https://ratings.fide.com/profile/3802272`).

[2]For example, based on the results obtained at the FIDE World School Chess Championship 2022, Peru was awarded the title of World Chess Champion Country in Panama (with 6 top positions in school categories). `https://federacionperuanadeajedrez.org/peru-campeon-en-el-campeonato-mundial-escolar-panama-2022/`).

in developing countries. Despite Peru's strong presence in international youth chess, there is a notable lack of academic research that analyzes determinants of Peruvian players' performance.

More broadly, predicting individual and team performance in sports is of great interest due to its implications for competitive success, economic returns, and reputation. In sports literature, different models have been proposed to predict player and team performance, which include variables such as age, experience of rugby players, along with physical attributes like fat level (Fontana et al., 2017). In chess, identifying variables that can predict a player's probability of winning a medal in a championship would help to improve national team competitiveness. Such insights would enable the selection of players with a higher likelihood of winning a medal and the design of targeted strategies to maximise their performance.

This study has two main objectives. First, it aims to determine whether socioeconomic variables can predict the probability of young Peruvian chess players winning medals in a competition. To achieve this, we analyze data from the "National Survey of Youth Chess Players participating in the 2021 Pan Floripa", conducted by the Peruvian Chess Sports Federation (FDPA) following the XXXI Pan American Youth Hybrid Festival 2021 (Pan Floripa 2021). Using a logistic binary regression model estimated through maximum likelihood, we identify the most relevant variables that predict the probability of winning a medal.

Second, this paper examines gender differences in chess performance. Understanding these differences is crucial for addressing broader issues of gender equality and representation in competitive domains. Chess, historically male-dominated, provides a context to explore how societal norms, psychological factors, and structural barriers affect women's participation and performance. Research suggests that factors such as stereotype threat, psychological pressure, and lack of representation can negatively impact women's performance in mixed-gender settings (Maass et al., 2008; Backus et al., 2022). Identifying these challenges can help to create more supportive and inclusive environments that allow women to achieve their full potential.

Beyond chess, insights gained from studying gender differences in chess can be applied to other areas, such as STEM fields, where similar disparities persist. Understanding how gender stereotypes and societal expectations influence performance can contribute to policy discussions on reducing gender gaps and promoting diversity and inclusion in various professional and academic settings.

The results confirm the hypothesis that there are socioeconomic variables that help predict the probability of Peruvian players participating in the Pan Floripa 2021 competition winning a medal. Specifically, it is found that gender, having a title, age, quality of internet access, having siblings, and academic performance contribute to predicting the probability of winning a medal. While the estimated coefficients may not necessarily represent causal effects, the analysis suggests that the probability of a woman winning a medal is at least 26 percentage points higher than that of a man.

Furtermore, Oaxaca- Blinder and Ñopo decompositions indicate that this difference is explained by gender.

This research makes several key contributions to the broader literature on chess performance, socioeconomic determinants of success, and gender disparities in competitive fields. First, it expands the scientific literature on chess performance by providing, to the best of our knowledge, the first investigation focused specifically on young Peruvian chess players. Second, its findings have practical implications for enhancing the performance of Peruvian chess teams in international competitions. By identifying players with a higher likelihood of winning medals and developing targeted strategies to improve their performance, this study provides valuable insights for team selection and training programs. Third, the analysis of gender differences in chess performance not only enriches the field of cognitive and educational psychology but also offers broader insights into promoting gender equity and inclusivity in competitive and professional settings. Furthermore, this study is the first to examine performance differences among young chess players in an international tournament during the COVID-19 pandemic, shedding light on their results in a non-mixed gender competition.

The remainder of this document is structured as follows. In the second section, the theoretical framework and a review of relevant literature are presented. The third section describes the data used and provides key descriptive statistics. The fourth section explains the empirical methodology used to identify the primary socioeconomic predictors of chess performance. In the fifth section, the results obtained from the application of the proposed empirical methodology are presented and discussed. In the sixth section, recommendations derived from the results, main limitations, and potential avenues for future research are discussed. Finally, in the seventh section, the conclusions are presented.

2 Related literature

2.1 Chess performance

While no unified theory exists regarding the determinants of chess player performance, the various studies reviewed identify significant variables.

Personal characteristics encompass factors such as theoretical knowledge of the game, memory capacity, skill, playing experience, physical and psychological health, motivation, age, and gender. Lane and Chang (2018) conducted an experiment with 79 chess players, applying tests for chess position memory, chess knowledge, fluid intelligence, and a questionnaire on time spent playing chess outside of tournaments and studying chess. Their empirical analysis, based on correlations and a regression model, indicates that chess knowledge is the primary predictor of chess memory. Additionally, Bertoni et al. (2015) studied the age-productivity profile in chess, finding that productivity increases with age up to a peak and then declines, highlighting the importance of sustained engagement and practice.

Deliberate practice has been identified as a key factor in chess performance. De Bruin et al. (2008, 2014) investigated the role of deliberate practice and intelligence in chess performance, finding that practice significantly contributes to skill development. Their studies also noted that gender differences in chess performance are smaller than those related to deliberate practice, indicating that practice and motivation are critical determinants of success.

Gonzalez and Palacios (2016) evaluated the effect of psychological factors on players' performance in a competitive chess environment. They used a natural experiment that randomly assigned different emotional states to competitors. The experiment involved competitors playing an even number of games (between 8 and 10) and alternating the colors of the pieces. The initial piece assignment, known to confer an advantage with the white pieces, affected the emotional state of the players. Although each player had an equal number of games with both colors, the results showed that the player who played the first game with the white pieces won 60 percent of the games, providing evidence that psychological factors affect chess performance.

Environmental characteristics can also influence chess performance. Zak (2021) analyzed the performance of chess players in domestic versus international competitions. The study demonstrated that players who travel abroad for tournaments increase their winning chances by approximately 2 percent, suggesting a positive impact of competing in a different country. Künn et al. (2019) analyzed the effect of environmental conditions on competitive chess performance in amateur tournaments in West Germany. The results indicated that air pollution hinders cognitive performance in chess players, with higher pollution increasing the probability of errors.

Forrest et al. (2023) examined the relationship between education and winning chess medals at the country level. Their results showed that, in addition to population size, per capita GDP, and political system, greater exposure to education is associated with greater chess success. Education enhances productivity through cognitive capacity development, especially in knowledge-intensive activities like chess, and promotes soft skills and specific sports training. Jerrim et al. (2018) note that chess is part of the school curriculum in Armenia and Hungary.

Research consistently demonstrates the cognitive benefits of playing chess, particularly in educational settings. Aciego et al. (2012) found that chess enhances cognitive abilities, problem-solving capacity, and socio-emotional development in schoolchildren. Sala and Gobet (2016) conducted a meta-analysis confirming that skills acquired during chess instruction transfer to general cognitive and academic skills, with a stronger effect on mathematical skills. Similarly, Ortiz et al. (2019) reported that chess improves academic performance in mathematics and reading, supported by neuroscientific evidence showing brain activation during chess play. Islam et al. (2021) conducted a randomized field experiment to analyze the benefits of intensive chess training in a developing country, finding that chess helps improve mathematics scores.

However, the positive correlation between chess and academic performance is not

universally present. Gobet and Campitelli (2006) observed that while children engaged in chess might see slight academic improvements, their academic performance may deteriorate with competitive chess due to the extensive practice and study required.

Given this context, chess can be viewed as an intellectual sport that develops both cognitive and soft skills. Consequently, the effect of socioeconomic variables on chess performance is expected to be similar to their impact on other cognitive activities, such as academic learning. The literature establishes that student ability, family income, and socioeconomic status are primary determinants of academic performance. This is evidenced by Carvallo et al. (2007); Cervini et al. (2014); Poon (2020) for primary education, and by Gomes and Novo (2012); Ogunshola and Adewale (2012); Chandra and Azimuddin (2013); Ovansa (2017); Yulia (2017); Zwieten et al. (2021); Moreno and Cortez (2020); Xue et al. (2020); Daniele (2021) for secondary education.

2.2 Gender differences in chess performance

A substantial body of research has focused on gender differences in chess performance, often revealing that women underperform compared to men in mixed-gender settings. Gerdes and Gränsmark (2010) studied a database of 1.4 million international chess games over 11 years, finding that women are more risk-averse than men. They noted that men choose more aggressive strategies against women, even when such strategies reduce their winning probability. Backus et al. (2016) found that women perform worse against male opponents due to increased psychological pressure and stereotype threat. Maass et al. (2008) demonstrated that activating gender stereotypes led to a significant drop in women's performance when they knew they were playing against men. However, Stafford (2018) found that women can outperform expectations when playing against men, suggesting that the impact of stereotype threat may vary across different contexts.

Gender stereotypes and psychological factors play significant roles in chess performance. Brancaccio and Gobet (2023) reviewed the literature on gender differences in chess and STEM fields, highlighting the impact of socio-cultural and biological explanations. Howard (2013) and Maass et al. (2008) argued that gender stereotypes and societal expectations contribute to the underrepresentation of women in chess. De Sousa and Hollard (2022) documented that women compete worse against men in field tournaments across various countries, suggesting that stereotype threat and societal pressures influence performance.

Velickovic and Radovanovic (2018) discussed the underrepresentation and underperformance of women at the top levels of chess, attributing these disparities to factors such as confidence, aggressiveness, and societal expectations rather than innate ability. Blanch et al. (2015) analyzed sex differences in chess Elo ratings and found that age and practice significantly predict performance for females but not for males, indicating that the gender gap in chess may be influenced by differences in practice and socio-cultural factors.

The COVID-19 pandemic significantly impacted chess performance, particularly

regarding practice opportunities and online participation. Wang and Thompson (2023) examined gender differences in chess rating fluctuations during the pandemic, finding that while male players generally outperformed female players, the top 5 percent of female players showed more progress than their male counterparts. This suggests that the increased practice and online chess opportunities during the pandemic may have helped reduce some of the traditional gender disparities in chess performance.

3 Data

3.1 Data description

Data was obtained from the "National Survey of Youth Chess Players Participating in the 2021 Pan Floripa," which comprises 28 questions divided into five sections: (1) Personal Information, (2) Socioeconomic and Demographic Information, (3) Academic Performance and Learning, (4) Chess Training, and (5) Performance in the Hybrid Pan American Championship and Perceptions. This survey was developed and administered online by the Peruvian Chess Sports Federation (FDPA) to 72 Peruvian child and youth chess players during the second half of 2021, following the XXXI Hybrid Pan American Youth Festival (Pan Floripa 2021). The survey facilitated the collection of data on personal and socioeconomic characteristics, academic performance, and chess-related characteristics of the child and youth chess players before and during the COVID-19 pandemic. The variables identified within the dataset as potential drivers of chess performance are detailed in Table 1:

The international championship was organized by the Confederation of Chess for America and the Brazilian Chess Federation, from September 4th to 10th, 2021, during the COVID-19 pandemic. Due to the sanitary measures imposed in all countries, the event was conducted in a hybrid format using the online platform Tornelo, combining in-person participation of the players with virtual chess. The international championship brought together over 500 young chess players from 15 countries across the Americas.[3]

It is important to note that the COVID-19 pandemic posed significant challenges for organizing national and international sports events due to global restrictions aimed at preventing the spread of the virus. Despite these challenges, according to the United Nations (2021), chess demonstrated remarkable resilience, doubling its activity and quickly adapting to online play.

3.2 Descriptive Statistics

Table 2 displays the descriptive statistics for the variables included in the econometric model. The sample consists of 72 players. The variable "Prize" is binary, taking the value 1 if the player won a prize (first, second, or third place) in the championship and

[3]The information is obtained from the list of participants in the XXXI Pan American Youth Chess Festival 2021 - HYBRID published on the Chess Results server (open and girls' categories `https://chess-results.com/tnr577204.aspx?lan=1&art=0&turdet=YES&flag=30`).

Table 1. *Information from the National Survey of Youth Chess Players Participating in Pan Floripa 2021.*

Personal Characteristics	
Gender	Age
Socioeconomic Characteristics	
Region of origin	Health insurance
Region of residence	Type of school
Has siblings	Mother's educational level
Father's educational level	Mother's stable job
Father's stable job	Perception of monthly income
Academic Performance	
Preference for virtual classes	Performance during the pandemic
Performance in face-to-face classes	
Chess-related characteristics	
FIDE title[a]	FIDE rating[b]
Type of training before the pandemic	Perception of performance
Type of training during the pandemic	Preference for types of tournaments
Perception of performance in the championship	

Note. Own elaboration.

[a] According to the World Chess Federation (FIDE), a FIDE title is an official recognition of a player's skill and achievements in chess. FIDE titles for players are administered by the FIDE Qualification Commission and can only be obtained over-the-board standard chess. `https://handbook.fide.com/chapter/B012024`.

[b] In addition to FIDE titles, players are also ranked using the FIDE Rating system, which is a numerical system in which fractional scores are converted to rating differences and vice versa. Ratings typically start at around 1000 and go up to over 2800 for the top players in the world. `https://handbook.fide.com/chapter/B022024`.

0 if not. The average value is 0.17, indicating that only 17 percent of the participants won a prize. The average age is 11.6 years, with ages ranging from 6 to 18 years.

Table 2. *Descriptive Statistics*

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Prize	72	0.17	0.38	0	1
Won a medal	72	0.17	0.38	0	1
Age	72	11.61	3.04	6	18
Gender					
Male	72	0.63	0.49	0	1
FIDE title					
Yes	72	0.08	0.28	0	1
Quality of internet access					
Good	72	0.44	0.50	0	1
Siblings					
Yes	72	0.69	0.46	0	1
Academic performance					
High	72	0.83	0.37	0	1
Father has a stable job					
Yes	72	0.68	0.47	0	1

Note: Own elaboration.

The remaining variables are binary: "Gender, " "FIDE title," "Quality of Internet Access," "Siblings," "Academic Performance," and "Father Has A Stable Job".

"Gender" is coded as 1 for male and 0 for female, with 63% of participants being male. The "FIDE Title" variable takes the value 1 if the player holds a FIDE title, and 0 otherwise, with 8% of players holding a title on average. The "Quality of Internet Access" variable is set to 1 for those reporting good internet connectivity during the COVID-19 pandemic, and 0 for regular or poor connectivity; 44% of participants reported having good internet access. The "Siblings" variable is coded as 1 if the player has at least one sibling, and 0 if not, with 69% of participants having siblings. The "Academic Performance" variable is set to 1 for players who had high academic performance before the pandemic, and 0 for those with regular or low performance; 83% of participants reported high academic performance. Finally, the "Father Has Stable Job" variable is coded as 1 if the father has stable employment, and 0 otherwise, with 68% of participants indicating their father had stable job.

4 Empirical methodology

To determine the most relevant variables that help predict whether a chess player will win a medal (first, second, or third place), binary logit regression models will be estimated. To do this, g_i is defined as a binary variable that takes the value 1 if participant "i" wins a medal and 0 otherwise. Then, following Stock and Watson (2020) the population regression model for g_i is:

$$\begin{aligned} g_i &= E[g_i|x_i] + u_i \\ g_i &= 1 \times P(g_i = 1|x_i) + 0 \times P(g_i = 0|x_i) + u_i \\ g_i &= P(g_i = 1|x_i) + u_i \end{aligned}$$

where x_i is a vector containing all the potential variables that determine the probability of $g_i = 1$. It is assumed that $P(g_i = 1|x_i)$ is a logistic probability function that depends on a linear combination of the elements of x_i:

$$P(g_i = 1|x_i) = \frac{e^{x_i'\beta}}{1 + e^{x_i'\beta}} = \frac{1}{1 + e^{-x_i'\beta}}$$

therefore, the model is termed logit or logistic. The estimation of the β vector in the logit model will be carried out using the maximum likelihood estimator (MLE). To do this, given that $F(x_i'\beta) \equiv Pr[g_i = 1|x_i; \beta]$, the likelihood function is defined as:

$$L(\beta|x) = \Pi_{i=1}^{N}[F(x_i'\beta)]^{g_i}[1 - F(x_i'\beta)]^{1-g_i}$$

and the log-likelihood function as:

$$\log L(\beta; g_i, x_i) = \sum_{i=1}^{N} g_i \log F(x_i'\beta) + \sum_{i=1}^{N}(1 - g_i) \log[1 - F(x_i'\beta)]$$

Therefore, the maximum likelihood estimator(MLE) of the β vector is the $\hat{\beta}^{MV}$ vector that maximizes the log-likelihood function.

The best specification of the logit regression model will be determined based on the individual and joint significance of the regressors, as well as the model's goodness of fit. For the latter, the McFadden's R^2 will be used, defined as:

$$\text{pseudo-}R^2 = 1 - \frac{l_1}{l_0}$$

where l_1 is the logarithm of the likelihood function for the considered specification, and l_0 is the logarithm of the likelihood function for the specification that includes only a constant; the higher the pseudo-R^2 the greater the predictive capacity of the model. Goodness of fit will also be analyzed through: the Akaike Information Criterion (AIC), the Bayesian Information Criterion (BIC), sensitivity (percentage of observations with $g_i = 1$ correctly predicted), specificity (percentage of observations with $g_i = 0$ correctly predicted), percentage of observations correctly classified, the Area Under the Receiver Operating Characteristic (ROC) Curve, and the Hosmer-Lemeshow test. Once the best specification with statistically significant parameters is identified, average marginal effects will be calculated to determine the contribution of each variable to the probability of winning a medal.

5 Results

To determine the best logit model that aims to predict the probability of a chess player winning a medal, several specifications were estimated. The most reasonable models include the variables "Female" (1 if female and 0 if male), "Age" (in years), "Internet" (1 if the quality of the internet connection is good and 0 if it is regular or poor), "Siblings" (1 if they have at least one sibling and 0 if not), "Academic Performance" (1 if their academic performance before the pandemic was high and 0 if it was regular or low), and "Father's Job" (1 if the father has a stable job and 0 if not).

The results of the best specifications are presented in the Table 3. In each entry, the first number represents the estimated coefficient, and the second number represents the corresponding robust standard (White, 1980). Across models, all coefficients are individually significant at least at the 10 percent level (one asterisk). According to the p-value of the Chi-square test (χ^2), in all models, all predictors are jointly significant together at the 1 percent level.

Table 3. *Coefficient Estimates from Logit Models: Predicting the Probability of Wining a Prize*

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Female	1.946***	2.869***	2.886***	2.897**	3.728***	3.547***
	(0.72)	(1.09)	(1.11)	(1.15)	(1.35)	(1.31)
Title		3.892***	5.239***	5.722***	6.608***	6.038***
		(1.34)	(1.62)	(1.84)	(2.01)	(2.05)
Age			-0.275*	-0.391**	-0.447**	-0.448**
			(0.15)	(0.18)	(0.21)	(0.21)
Siblings				2.373*	2.934*	2.638
				(1.28)	(1.69)	(1.67)
Good internet					2.705**	2.648**
					(1.17)	(1.16)
Good academic perf.						-1.919
						(1.96)
Father's job						-0.579
						(1.06)
Constant	-2.639***	-3.794***	-0.914	-1.551	-3.777*	-1.116
	(0.60)	(1.02)	(1.81)	(2.01)	(2.23)	(2.92)
Observations	72	72	72	72	72	72
Joint signif. (prob.)	0.004	0.000	0.000	0.000	0.000	0.000
pseudo-R2	0.130	0.309	0.365	0.440	0.553	0.573
AIC	60.42	50.82	49.17	46.35	40.97	43.69
BIC	64.97	57.65	58.28	57.73	54.63	61.90
Sensitivity(%)	0.00	33.33	41.67	58.33	66.67	66.67
Specificity(%)	100.00	96.67	95.00	96.67	95.00	98.33
Correct-Clas.(%)	83.33	86.11	86.11	90.28	90.28	93.06
ROC	0.72	0.83	0.89	0.92	0.95	0.95
Hosmer-Lemeshow (prob.)		0.91	0.12	0.63	0.42	0.49

Note. Significance levels: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

In terms of goodness of fit, according to the pseudo-R^2 models 5 and 6 fit the data better, while according to the AIC and BIC information criteria, model 5 has the best fit, as it has the lowest AIC and BIC values. Models 5 and 6 possess the highest sensitivity (the number of players who won a prize and are correctly predicted by the model, expressed as a percentage of the total players who won prizes), while Model 1 displays the best specificity (the number of players who did not win prizes and are correctly predicted by the model, expressed as a percentage of the total players who did not win prizes); however, all models display a percentage greater than or equal to 95 percent. Models 5 and 6 have the highest percentage of correctly classified observations (the number of correct predictions expressed as a percentage of the total observations) and the highest area under the ROC curve are models 5 and 6. Additionally, the Hosmer-Lemeshow test (HL) indicates that all models have a good fit (p-value is greater than 0.10). Based on these results, it can be concluded that models 5 and 6 are the models with the best ift; however, model 5 is prioritized as all of its coefficients are statistically significant.

The estimated coefficients in Table 3 do not represent the average marginal effects; however, they indicate the direction in which the predicted probability changes with a change in the corresponding regressor. The results indicate that the probability of a

player winning a prize is, on average, higher for females, for players that won a title before, have siblings and access to good quality internet, whereas it diminishes with age and if the father has a stable job (although it is not statistically significant).

The average marginal effect for each explanatory variable are presented in the Table 4. For interpretation, we focus on model 5. The marginal effect of "Female" indicates that, on average, a woman's probability of winning a prize is 24.6 percentage points (pp) higher than that of a man, a result consistent with previous research (e.g. Dilmaghani, 2020).

Table 4. *Average Marginal Effects from Logit Models: Predicting the Probability of Winning a Prize*

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Female	0.267***	0.276***	0.262***	0.234***	0.246***	0.251***
	(0.10)	(0.09)	(0.08)	(0.08)	(0.07)	(0.08)
Title		0.564***	0.703***	0.692***	0.640***	0.627***
		(0.17)	(0.13)	(0.15)	(0.14)	(0.16)
Age			-0.024**	-0.030**	-0.028***	-0.026**
			(0.01)	(0.01)	(0.01)	(0.01)
Siblings				0.159**	0.156**	0.133*
				(0.06)	(0.06)	(0.07)
Good internet					0.172***	0.170***
					(0.06)	(0.07)
Good academic perf.						-0.137
						(0.15)
Father's stable job						-0.035
						(0.07)
Observaciones	72	72	72	72	72	72

Note. Significance levels: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

The marginal effect of having previously won a title is the largest among all variables. Specifically, a player who already holds a title has a 64 percentage points higher probability of winning a medal. This result highlights that experience and prior success in competitive chess is key to win a medal. Winning a title not only reflects a player's advanced skill level and better training opportunities but may also provide increased confidence and resilience under pressure.

Regarding variable "Age", each additional year of age reduces the probability of winning a prize by 2.8 percentage points on average. This finding based on players aged 5 and 18, partially aligns with Bertoni et al. (2015), which shows that a chess player's performance increases from the age of 15 (the starting age of their study) and reaches its peak at 21.6 years. Similarly, Strittmatter et al. (2020) find that a chess player's career peak occurs early, with no significant improvements beyond age 30.

For the variable "Siblings," having at least one sibling increases the probability of winning a medal by 15.6 percentage points. This result supports the idea that

chess is a skill-intensive sport where frequent practice is essential ("practice makes perfect"). Playing against siblings may provide opportunities to refine strategies, analyze mistakes, and enhance performance. Moreover, chess among siblings can be both an enjoyable and educational experience. A well-known example of sibling influence in chess is the Polgar sisters: Judit, Susan, and Sofia. In Polgar (1989/2017), their father, László Polgar, highlights that while a good sibling can be valuable, a strong friendship can sometimes be even more beneficial. He argues that the extent to which siblings foster healthy competition and mutual improvement depends largely on parental guidance and home education.

The marginal effect of "Internet" indicates that players with good internet connectivity are 17.2 percentage points more likely to win a medal compared to those with regular or poor connectivity. This result suggests that access to stable internet facilitates uninterrupted training and improving performance, particularly in hybrid competitions where online preparation is crucial. Moreover, since high-quality internet is more common in higher-income households, "Internet" may also capture the advantages associated with greater financial resources, such as access to better coaching, educational materials, and an overall better standard of living.

Model 6 includes two additional explanatory variables: academic performance and father's job. Although neither is statistically significant, their interpretation remains insightful. Regarding academic performance, players who reported good academic performance before the pandemic have a 13.7 percentage point lower probability of winning a medal compared to those with regular or low academic performance. This result is consistent with Gobet and Campitelli (2006), which shows that due to the extensive practice required to achieve expertise in chess can limit the development of other skills, including academic ones. The finding suggests a potential trade-off between mastering chess and academic success, as both demand significant time and cognitive effort.

The stability of father's job reduces the probability of winning a medal by 3.5 percentage points on average. This suggests that children from less stable economic backgrounds might be more motivated to excel in chess as a potential pathway to scholarships, sponsorships, or career opportunities.

In summary, several sociodemographic factors help predict the probability of winning a medal in a chess championship. These include gender, title, age, internet access, siblings, and academic performance. Additionally, it's important to note that while the estimated marginal effects do not necessarily imply causality, the stability of the estimated coefficient for the "Female" variable across specifications (ranging between 0.23 and 0.28) suggests that it can be considered a good approximation of the causal effect of being female. Thus, the probability of a woman winning a medal is around 25 percentage points higher than that of a man.

Gender differences are tested using both Oaxaca-Blinder and Ñopo decompositions. Table 5 display the results.

Results indicate that the difference in the average probability of winning a medal

Table 5. *Oaxaca-Blinder and Ñopo decomposition*

	Model 2	Model 3	Model 4	Model 5
Oaxaca-Blinder decomposition				
Differential				
Females	0.333***	0.333***	0.333***	0.333***
	(0.037)	(0.092)	(0.092)	(0.092)
Males	0.067**	0.067	0.067	0.067
	(0.020)	(0.037)	(0.037)	(0.038)
Difference	0.267***	0.267**	0.267**	0.267**
	(0.042)	(0.099)	(0.099)	(0.099)
Decomposition				
Explained	-0.008	0.001	0.020	-0.005
	(0.037)	(0.041)	(0.047)	(0.052)
Unexplained	0.275***	0.266**	0.247**	0.272***
	(0.009)	(0.083)	(0.080)	(0.079)
Total gap	4.00	4.00	4.00	4.00
Unexplained	4.12	3.98	3.70	4.07
Ñopo decomposition				
Total gap	4.00	4.00	4.00	4.00
Unexplained	4.16	3.10	2.75	2.25
	(1.377)	(0.783)	(0.880)	(0.569)
Common support				
Perc. of males	1.000	0.889	0.741	0.630
Perc. of females	1.000	0.933	0.667	0.444

Note. Significance levels: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. perc. of

between females (0.333 or 33.3%) and males (0.067 or 6.7%) is 0.267 or 26.7 p.p. and statistically significant at the 5% level, which means that females performed better in the Peruvian team. Across models, the explained component is statistically insignificant, which means that observable factors such as title, age, siblings, and internet quality explain almost none of the gender difference in medal success. On the contrary, most of the difference in success (between 0.247 and 0.272) remains unexplained, possibly due to gender and other unobserved factors like motivation, coaching quality, psychological factors, among others. Given that after controlling for other available variables, the estimated unexplained gap is stable around 0.3 (rounded to 1 decimal), the results suggest that the unexplained part can be reflecting the contribution of gender. Therefore, the difference in the probability of winning a medal between females and males is basically due to gender.

The results from Ñopo decomposition are quite similar to those of the Oaxaca-Blinder decomposition. For comparison reasons, it is worth it to express the total gap and the unexplained difference Oaxaca-Blinder decomposition as a percentage of the predicted probability for males. The total gap is $0.267/0.067 = 4.00$ or 400% and the part of the gap due to gender differences (unexplained gap) is $0.272/0.067 = 4.07$ or

407%.

In Model 5, the total difference in the probability of winning a medal between females and males, expressed as a percentage of the probability for males, is 4 or 400%. The part of this gap explained by gender differences (unexplained gap) is 2.25 or 225%, which is statistically significant given the standard error in parenthesis (0.569 which implies a t-statistic of 3.95). Similar to the OB results, the unexplained gap decreases after including all available controls, dropping from 4.16 (Model 2) to 2.25 (Model 5). This pattern suggests that the remaining unexplained gap, reflects the direct contribution of gender.[4]

6 Implications

The obtained results can be utilized to enhance the performance of Peruvian chess teams in international competitions. On one hand, the estimated model allows for the identification of Peruvian players with a high probability of winning in a championship, considering their socioeconomic characteristics. This would aid in forming a team with better chances of winning.

On the other hand, the estimates can inform the development of evidence-based strategies aimed at boosting the performance of chess players from diverse socioeconomic backgrounds. For instance, in the case of the effect of being female, the results suggest that training for male players should be reinforced, as they have a lower probability of winning (*ceteris paribus*). Another relevant finding is the effect of the variable "having access to quality internet", which is controlled by factors associated with income and socioeconomic status in general. Given that better internet connectivity significantly increases the likelihood of winning a medal, it is recommended that the Peruvian Chess Sports Federation (FDPA) and other relevant institutions implement targeted interventions to support players from lower-income households. These efforts could include expanding access to digital infrastructure, providing online learning platforms, and offering remote coaching opportunities, particularly for players in underserved regions.

From a broader public policy perspective, several implications emerge. First, a national early-talent identification system could be developed using predictive indicators such as gender, age, competitive experience (e.g., FIDE titles), internet access, academic performance, and family context (e.g., having siblings). This tool would support the Peruvian Chess Sports Federation (FDPA) and affiliated institutions in forming more competitive and inclusive teams with greater chances of international success.

Second, the integration of chess into school curricula, especially in public schools,

[4]Notice that the common support drops to 0.44 and 0.63 for females and males, respectively, which indicates that the decomposition is based on 44% and 63% of comparable people.

could help reinforce the cognitive and emotional benefits of the sport, particularly for students in contexts of educational vulnerability. Given the literature highlighting the positive relationship between chess and academic skills, such a policy could help bridge learning gaps while simultaneously identifying new talent.

Third, the findings underscore the role of chess as a potential pathway for social mobility and personal development. The fact that children with unstable socioeconomic backgrounds (e.g., lacking a father with a stable job) still manage to succeed in chess suggests that the sport may serve as a compensatory mechanism, offering alternatives for achievement and recognition. Thus, investing in chess programs within low-income communities may contribute to broader social inclusion goals.

Finally, it is important to acknowledge the main limitations of the research, which also present opportunities for possible extensions. The first limitation is that causal effects are not estimated, which might limit the use of results for proposing interventions or policies to improve academic performance. As an extension, it would be valuable to identify an instrumental variable that allows for measuring the causal effect of some of the analyzed variables. For instance, in the case of the estimated effect of the "female", variable, it could be considered a good approximation of the causal effect of being female, as the estimate remains relatively stable after controlling for other characteristics and the Oaxaca-Blinder and $\tilde{\text{N}}$opo decompositions provide similar results.

A second limitation is the size and scope of the sample, which consists of only 72 chess players who participated in the Pan Floripa 2021 championship. In this case, the results should be approached cautiously if extrapolating them beyond the sample. Overcoming this limitation could involve collecting more information from both players and championship results. In this regard, the role of the Peruvian Chess Sports Federation (FDPA) and the support it receives from the government will be crucial.

Lastly, chess performance is measured through a binary variable (whether a player won a medal or not). A possible extension of this work could involve measuring chess performance based on the player's final ranking in the championship. This could be analyzed using an ordered discrete choice model (ordered logit or probit), which would provide more granular insights into the determinants of chess success across performance levels.

7 Conclusion

This study had two main objectives. The first one was to determine whether socioeconomic variables can predict the probability of young Peruvian chess players winning medals in a competition. Based on the estimation of a logistic binary regression model and data from the "National Survey of Youth Chess Players participating in the 2021 Pan Floripa", it is found that gender, having a title, age, quality of internet access, having siblings, and academic performance contribute to predicting the

probability of winning a medal. The second objective was to assess gender differences in chess performance. Regarding this, the results indicate that the probability of a woman winning a medal is at least 26 percentage points higher than that of a man. Oaxaca- Blinder and Ñopo decompositions confirmed that this difference in chess performance is due to gender and not to other observable socioeconomic characteristics.

This paper makes several contributions. To the best of our knowledge, it is the first investigation focused specifically on young Peruvian chess players. Second, by identifying players with a higher likelihood of winning medals and developing targeted strategies to improve their performance, this study provides valuable insights for team selection and training programs. Third, the analysis of gender differences in chess performance not only enriches the field of cognitive and educational psychology but also offers broader insights into promoting gender equity and inclusion in competitive and professional settings. Furthermore, this study is the first to examine performance differences among young chess players in an international tournament during the COVID-19 pandemic.

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