

Development of elite athletes: An approach from the partial least square path modelling Desarrollo de atletas de élite: Una aproximación desde el modelado de ruta de mínimos cuadrados parciales

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Abstract. Literature about elite sports management tends to focus on the analysis of qualitative level of its success factors, especially among developed countries. In consequence, the aim of this study is to perform a predictive causal analysis that examines the factors influencing the development of elite athletes within the Valle del Cauca region in Colombia. 171 valid surveys were performed to direct stakeholders of elite sports. The goodness of fit, the composite reliability, the discriminant validity and the proposed structural model were examined by using the partial least square path modelling via ADANCO software. Empirical results show that for the population under study, competitions ($p=.000$), sports talent ($p=.002$), administration of the system ($p=.02$) and the cultural aspects ($p=.002$) are the factors that have a direct and positive influence on development of athletes; whereas hypothesis of funding, infrastructure, coaches and scientific research were rejected. This article contributes to the existing literature by providing knowledge of the factors influencing the development of elite athletes within a developing region from a quantitative approach.

Keywords: Elite sports; Developing region; PLS path modeling; Sports development.

Resumen. La literatura sobre la gestión del deporte de élite tiende a centrarse en el análisis a nivel cualitativo de sus factores de éxito, especialmente en los países desarrollados. En consecuencia, el objetivo de este estudio es realizar un análisis causal predictivo que examine los factores que influyen en el desarrollo de atletas de élite en la región del Valle del Cauca, Colombia. Se aplicaron 171 encuestas válidas a los stakeholders directos del deporte de élite. Se examinó la bondad de ajuste, la fiabilidad compuesta, la validez discriminante y el modelo estructural propuesto utilizando el método de modelado de ruta de mínimos cuadrados parciales en el software ADANCO. Los resultados empíricos demuestran que, para la población objeto de estudio las competencias ($p=.000$), el talento deportivo ($p=.002$), la administración del sistema ($p=.02$) y los aspectos culturales ($p=.002$) son los factores que tienen una influencia directa y positiva sobre el desarrollo de atletas. Mientras que, las hipótesis de apoyo financiero, infraestructura, entrenadores e investigación científica fueron rechazadas. Este artículo contribuye a la literatura existente al proporcionar conocimiento desde un enfoque cuantitativo sobre los factores que influyen en el desarrollo de atletas de élite en países en desarrollo.

Palabras clave: Deporte de élite; Región en desarrollo; PLS path modeling; Desarrollo deportivo.

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Introduction

There is increasing evidence for the positive impacts of elite sports on society (De Rycke et al., 2019; De Rycke & De Bosscher, 2019, 2020). Elite sports refers to any athlete or team competing at the highest national or international levels in Olympic or non-Olympic sports, professional sports, team sports and emerging sports (Sotiriadou & De Bosscher, 2018). To achieve high sports performance, it is essential to address numerous individual and contextual factors (López-Gajardo et al., 2022). The development of elite athletes is a process in which converge a great number of organizations and actors offering training opportunities at specialized facilities, coaching for skills development, identification and selection of talents, and transition towards higher levels of competition (Rees et al., 2016). However, the complex nature of this process has not been widely explored and theorized (De Bosscher et al., 2015), especially in developing countries (Riot et al., 2019). Furthermore, previous studies in different countries showed that the degree of development of different factors, priorities and perceived relevance is diverse (Hopkinson et al., 2018).

Empirical studies on elite sport from a multidimensional perspective are still scarce (Manuel et al., 2023).

Literature about elite sports management tends to focus on the analysis of qualitative and descriptive level of international success factors (De Bosscher, 2018), especially among developed countries. The potential of current approaches to produce an explanation on the causal links between independent and dependent variables in elite sport success is limited (Henry et al., 2020). In consequence, the aim of this study is to perform a predictive causal analysis, by following the partial least square path modelling method, which enables examining the factors influencing the development of elite athletes within the Valle del Cauca region in Colombia. This article contributes to the existing literature from a quantitative approach, by providing knowledge about policy factors influencing the development of elite athletes within a developing region.

The structure of this article is as follows. In the introduction, the research problem and the purpose of the study are presented. In the literature review, factors influencing the development of elite athletes are analyzed and research hypotheses are suggested. In the methodology authors present the partial least square path modelling method and the structural model proposed. Finally, the results, discussion, conclusions, limitations and potential future research are addressed.

Literature review and hypotheses development

An elite athlete is the person who receives direct or indirect funding and/or any other services via a support program funded and/or organized on a national (or regional) context aiming to achieve success at different levels of senior competition (De Bosscher & De Rycke, 2017). The development of elite athletes is a complex phenomenon that cannot be understood separately (Patatas et al., 2020). This is a process influenced by a dynamic interaction between context factors of the athlete, the environment and the system of sports development (Gulbin & Weissensteiner, 2013). There is a growing interest in identifying the common characteristics of elite sports systems that are successful at an international level (Valenti et al., 2019). Some studies agree that adequate funding, system administration, talent development, coach training, sports facilities, competition systems and scientific research are common characteristics for success at an international level in elite sports (De Bosscher et al., 2015; Truyens et al., 2014). However, the relationship between these components can be continuously reorganized as performance targets change (Davids et al., 2014). As a consequence, the development of elite athletes is a nonlinear phenomenon in which several factors conditioning sports success converge (Gulbin et al., 2013).

Funding of elite sports

The financing of sports worldwide depends mainly on the states and their sports development policies (Berrett & Slack, 2001; Brouwers et al., 2015; Funahashi et al., 2019; M. Green & Houlihan, 2006; Winand et al., 2012). The way in which sports budgets are allocated is almost always based on sports performance (Sam, 2012; Sotiriadou et al., 2006) and their increase depends largely on the results obtained by athletes in events of the Olympic cycle, world championships, professional events and other international sports competitions (De Bosscher et al., 2015; M. Green & Oakley, 2001). Therefore, it is necessary for nations to continue investing in elite sports and thus maintain the results obtained in sports that are considered as priority (De Bosscher et al., 2019). Therefore, the following hypothesis is proposed:

H1. There is a direct and positive relationship between funding and the development of elite athletes.

Coaches

Access to world class coaches is recognized by athletes as one of the most important supporting services they receive during their preparation and competition processes (M. Green & Houlihan, 2005). Coaches require adequate knowledge and tools that allow them to support the development of their athletes (Lebrun et al., 2020). However, it is difficult for coaches to perform their job full time (De Bosscher et al., 2009), leading to the coach's experience, remuneration, access to education, and skills development rarely at a high level (Smolianov et al., 2014,

2016). Some sports systems have certifying and ranking programs for coaches, which allow their classification according to their knowledge and acquired experience. Therefore, the following hypothesis is proposed:

H2. There is a direct and positive relationship between coaches and the development of elite athletes.

Sports facilities

The ease of access for first-class sports facilities for training and competition purposes plays a vital role in the development of elite athletes (De Bosscher et al., 2015; Sotiriadou & Shilbury, 2009). Available facilities that enable the combination of academic training and sports are the most important factor for determining the satisfaction of young elite athletes (Elling & Reijgersberg, 2017). Guaranteeing public access to sports facilities to enhance the participation of all and to promote the interest for a healthy lifestyle, combined with programs for identifying and perfecting sports talent, is a key factor for developing elite athletes (Kristiansen, 2017). Therefore, the following hypothesis is proposed:

H3. There is a direct and positive relationship between sports facilities and the development of elite athletes.

System administration

An elite sports system comprises of the structures, systems and processes used to identify, develop and prepare athletes for international sports success (Lucidarme et al., 2018). The literature suggests that elite sports needs to be planned, designed, offered and monitored adequately to be successful (B. Green, 2005; Newland & Kellett, 2012; Phillips & Newland, 2014). The management of a sports system is based on aspects such as accountability, efficiency, planning, good financial management and the transparency of its sports organizations (Geeraert et al., 2014). This requires good practices in sports organizations (corporate governance), an articulated system supporting them (systemic governance) and a political framework that promotes direct and indirect strategies for intervention and control (political governance) (Shilbury & Ferkins, 2020). Therefore, the following hypothesis is proposed:

H4. There is a direct and positive relationship between the system management and the development of elite athletes.

Sports competitions

Sports competition programs are one of the common factors for promoting the development of elite sports (Truyens et al., 2016; De Bosscher et al., 2015). The organization of sports events and their legacy generate positive effects, such as the development of talented athletes (De Bosscher et al., 2013). The improvement in athletes' performance is boosted by a competitive environment that encourages participation in events characterized by a highly dynamic internationalization (De Bosscher et al., 2012). Good organization of a sports structure

presupposes that athletes have greater access to high-level events and, as a result of that, they also have better sports performance (Truyens et al., 2016). Therefore, the following hypothesis is proposed:

H5. There is a direct and positive relationship between sports competitions and the development of elite athletes.

Development of sports talent

Scientific evidence indicates that success in elite and super-elite athletes is not correlated with training volume, early specialization and the effects of relative age (ER) (Fernandez Ortega et al., 2021). However, Green (2005) describes three basic tasks for developing elite athletes: athletes' recruitment, athletes' retention, and athletes' transition towards higher competition levels. Côté & Lidor (2013) suggest that policies and programs focused on the identification and the development of talent are characterized by the early selection and specialization in a single sports discipline. De Bosscher & De Rycke (2017) found that world-class athletes began the practice of their sport early and received support in their preparation processes before lower-level athletes. Support services include training opportunities, access to international competitions, technical, medical, nutritional and therapeutic support. Physical education and extracurricular school sports, have been identified as influential in programs for talent development (Fernandez-Rio & Méndez-Giménez, 2012), by offering opportunities to complement preparation processes of elite athletes and to access higher education (Kristiansen & Stensrud, 2020; da Costa et al., 2021). Therefore, the following hypothesis is proposed:

H6. There is a direct and positive relationship between the development of sports talent and the development of elite athletes.

Scientific research

Science and technological innovations are essential to the improvement of performance in elite sports contexts (Müller et al., 1999). Probability of success in elite sports increases when athletes' preparation processes are based on the interaction between best practices and science. This means that relevant research problems for elite sports need to be identified; ensure that applied research is funded and conducted in collaboration with the most important research institutions; and disseminate and put to work knowledge obtained from educational programs for coaches (Haugen, 2020). The usage of automated information systems and data analytics contributes to improving the quality of preparation processes of elite athletes as well as to the strategic decision making within sports organizations (Fried & Mumcu, 2017). Therefore, the following hypothesis is proposed:

H7. There is a direct and positive relationship between scientific research and the development of elite athletes.

Cultural aspects

Culture is an essential aspect of the context in which elite sports develop (Houlihan, 2009; Oakley & Green, 2011). History, tradition, role models and sports popularity transmit specific knowledge which are adopted by new generations and create a sports culture that is decisive for international sports success (Mazzei, 2016). Success in elite sports is characterized by cultural patterns that have consolidated in nations throughout time (Digel, 2005; Digel et al., 2006). The combination of several success factors for elite sports is specific to the context of every nation and its culture (De Bosscher et al., 2009). This suggests that cultural patterns are important for boosting elite sports success. Any culture that acknowledges elite sports as a positive aspect for a nation may be the origin of sustained and successful results of its athletes at an international level (Sotiriadou et al., 2013). Therefore, the following hypothesis is proposed:

H8. There is a direct and positive relationship between cultural aspects and the development of elite athletes.

Methodology

Partial least square path modeling

Among all structural equation methods based on variance, the partial least square path modelling is regarded as the 'most general and developed system' (McDonald, 1996, p. 240) and part of the most recent strategies for conducting quantitative research in sport management (Zhang et al., 2017). Its capacity for modelling and building up concepts in all disciplines (Höök & Löwgren, 2012) turns it into the preferred statistical tool for the study of success factors (Albers, 2010). Partial least square path modelling was chosen for the study based on the premise that the research object considers a theory that has not yet been empirically validated (Aldás, 2016). The principal advantage of this approach is that population distribution is not subject to restrictions, for which exploratory and confirmatory research may be carried out (Chin et al., 2003).

During the data analysis stage, Software ADANCO version 2.1.1 was used for the partial least square path modelling. Following the Henseler et al., (2016) methodology, the first step to validate the measure model was to analyze the content validity through the review and adaptation of scales from assessing models of elite sports already validated in literature (See Table 1). All constructs and their respective items were operationalized in a 5-point Likert scale (ranging from 1, "strongly agree" to 5 "strongly disagree"), which is a widely accepted practice in empirical research, where no standard measures exist for quantifying (Kumar, Stern, & Anderson, 1993). This was corroborated by carrying out three pilot studies with 30 samples each, which supported the statistical properties of the measures and assessment of the face and content validity of the constructs.

Table 1.

Definition of constructs

Constructs	Definitions	Source
Funding of elite sports	Allocation of financial resources for promoting elite sports.	Adapted from De Bosscher et al., (2006); De Bosscher et al., (2009).
Coaches	Staff that directs processes of preparation and competition of athletes.	Adapted from De Bosscher et al., (2006); De Bosscher et al., (2009).
Sports facilities	Infrastructure provided with the necessary means for learning, practice and sports competition.	Adapted from De Bosscher et al., (2006); De Bosscher et al., (2009).
System administration	Structures, systems and processes, in which an organization's network allocates resources, exercises control, communicates and coordinates with the purpose or promoting elite sports.	Adapted from Shilbury et al., (2013); Shilbury et al., (2020).
Competitions	Sports events that offer a high-level competitive environment.	Adapted from De Bosscher et al., (2006); De Bosscher et al., (2009).
Athletes' development	Processes for recruitment, retention and transition of athletes towards higher levels of competition.	Adapted from Green (2005).
Sports talent	Identification, selection and development of athletes with potential for sports success in the long term.	Adapted from Côté & Lidor (2013).
Science, technology and innovation	Scientific knowledge applied to the development of elite athletes.	Adapted from De Bosscher et al., (2006); De Bosscher et al., (2009).
Cultural aspects	History, tradition, role models and patterns that characterize elite sports.	Adapted from Houlihan (2009); Mazzei (2016).

Source: Adapted by authors.

Next, the model goodness of fit was analyzed (SRMR <0.08), as well as the composite reliability (AVE >0.5; Dijkstra-Henseler's $\rho >0.7$; Cronbach's $\alpha >0.7$), the discriminant validity (Fornell-Larcker, HTMT <1), and the analysis of the structural model for hypotheses testing through the bootstrap test of the general adjustment of the model (R², Path β , SE, t-value, Cohen's f^2). All represented values demonstrated the validity of the suggested model.

The context of the study

To understand the results of this study, the following section reports upon the context in which this research was conducted. Colombia is the seventh country at the Pan-American level, third at the Central American and Caribbean level, and champion at the South-American and Bolivarian levels. The country has won 28 Olympic medals. This study was developed in Valle del Cauca's region, which is the third largest regional economy in Colombia (10% of the country's GDP). This region was chosen due to its broad tradition in elite sports in Colombia; which makes of it a representative and relevant case for the study of policy factors that influence the development of elite athletes in a developing region.

Data collection and sample profile

Target population was made up of main stakeholders of elite sports (De Bosscher et al., 2010) within Valle del Cauca region, in Colombia, including: athletes, coaches, sports leaders and other support professionals. A questionnaire based survey method was adopted, as it enables results generalization, is easy to replicate and facilitates simultaneous research of a considerable number of factors (Pinsonneault & Kraemer, 1993). A total of 219 online surveys were performed, of which 171 were accepted for data analysis, which meets the suggested standard for partial least square methodology.

Most of the population subjects were male (113, 66%), and 58 (34%) were female. Most samples were from people older than 41 years old (67; 39.2%); the

second largest age group was made up of 46 subjects (27%) between the ages of 21 and 30 years old; followed by the third group of 43 subjects (25.1%) ranging from 31 to 40 years old. In relation to the role they play in the sports system, 64 subjects (37.4%) are athletes; 32 subjects (18.7%) are coaches; 24 subjects (14%) are sports leaders, and 51 subjects (29.8%) fulfill other functions.

Results

Goodness of fit test

Prior to examining the measure and the structural model, the assessment of the model's goodness of fit must be performed (Henseler et al., 2016). For this purpose, ADANCO software provides the Standardized Root Mean Square Residual (SRMR) as the only appropriate adjustment measure of the model. According to Henseler et al., (2014), a value less than 0 or 0.08 (Hu & Bentler, 1998) is a good option for SRMR. For this study, the SRMR result was 0.0731, indicating that this model meets this criteria.

The global adjustment of the model was corroborated using the SEM methodology. The degrees of freedom of the Chi-square ($X^2=2.013$), the CFI (0.875) (Comparative Fit Index), the IFI (0.876) (Incremental Fit Index) and the root mean square error of approximation (RMSEA 0.07) represent a fit acceptable from the model (Bentler & Bonett, 1980; Browne, M; Cudeck, 1993; Hu & Bentler, 1998).

Composite reliability

For the analysis of reliability and validity, Anderson & Gerbing (1988) propose the evaluation of the psychometric properties of the questionnaire and of each one of the measurement scales. In order to guarantee the validity and reliability of the model, this study considers composite reliability (Henseler et al., 2016). Average Variance Extracted (convergent validity-AVE) was analyzed, as well as Cronbach α (internal model validity), the test of ρ_A Dijkstra-Henseler (reliability of construct scores) and the test of Jöreskog's ρ_c (>0.5). All values of factorial charges,

PA, Pc and Cronbach α are acceptable (> 0.7), justifying the reliability of constructs. Also, AVE values for all constructs indicate the convergent validity, as all values are above the minimum required level of 0.5 (See Table 2).

Discriminant validity

Additionally, for assessing the discriminant validity between constructs, the Fornell & Larcker (1981) cross-loadings and Heterotrait-Monotrait (HTMT) criteria were used. In the Fornell-Larcker test, loadings of an indicator against its own variable are, in all cases, greater than all its loadings crossed with other variables, thus, the test is valid (See Table 3).

Table 3. Discriminant validity – Fornell-Larcker criterion

Constructs	FU	CO	FA	SA	CP	AD	ST	SR	CU
Funding (FU)	0.8480								
Coaches (CO)	0.4354	0.6644							
Facilities (FA)	0.4251	0.4251	0.7824						
System administration (SA)	0.5189	0.5426	0.4502	0.7508					
Competitions (CP)	0.3827	0.3630	0.4143	0.5089	0.7406				
Athletes' development (AD)	0.4264	0.4168	0.3846	0.5642	0.5620	0.6546			
Sports talent (ST)	0.4057	0.4299	0.3574	0.5556	0.4658	0.5112	0.7822		
Scientific research (SR)	0.3581	0.4102	0.3059	0.4912	0.4918	0.4200	0.6515	0.8003	
Cultural aspects (CU)	0.2138	0.3132	0.2029	0.3107	0.3383	0.3730	0.2875	0.3248	0.5675

Source: The authors - ADANCO.

Table 4. Discriminant validity – HTMT

Constructs	FU	CO	FA	SM	CP	AD	ST	SR	CA
Funding (FU)	-								
Coaches (CO)	0.7686	-							
Facilities (FA)	0.7711	0.7390	-						
System administration (SM)	0.8226	0.8054	0.7479	-					
Competitions (CP)	0.7228	0.6740	0.7359	0.7816	-				
Athletes development (AD)	0.7679	0.7220	0.7077	0.8294	0.8502	-			
Sports talent (ST)	0.7261	0.7243	0.6606	0.7973	0.7483	0.7889	-		
Scientific research (SR)	0.7003	0.7320	0.6313	0.7722	0.7909	0.7314	0.8887	-	
Cultural aspects (CA)	0.5291	0.6203	0.4919	0.5916	0.6390	0.6826	0.5627	0.6281	-

Source: The authors - ADANCO.

Similarly, Henseler, Ringle, et al., (2014) suggest that a table with all Heterotrait-Monotrait (HTMT) correlations is required for examining the discriminant validity in the PLS approach (<0.9) (Teo et al., 2008). All HTMT values are below the required 0.9 value. Therefore, discriminant validity of all constructs is met (See Table 4).

Structural model

The 0.702 value of R^2 (See Figure 1) indicates that the suggested constructs predict a 70 percent change in athletes' development. Chin (1998) considers values for this test as follows: 0.67 (substantial), 0.33 (moderate) and 0.10 (weak). Hence, the suggested model has a substantial predictive power. Bootstrapping is an analytical technique that shows the level of significance of paths between each construct (Henseler et al., 2016). The results provided by the Bootstrapping procedure in ADANCO are achieved through resampling of hypotheses tests. In table 5 detailed Bootstrapping results are shown for the hypotheses tests.

The path (Beta) coefficients show the relationships be-

Table 2. Model composite reliability

Constructs	Items	AVE (>0.5)	Dijkstra-Henseler's (PA) (>0.7)	Jöreskog's rho (Pc) (>0.5)	Cronbach's α (>0.7)
Funding	2	0.8480	0.8208	0.9177	0.8207
Coaches	5	0.6644	0.8868	0.9081	0.8745
Sports facilities	3	0.7824	0.8702	0.9472	0.8614
System administration	6	0.7508	0.9375	0.9475	0.9332
Competitions	4	0.7406	0.8865	0.9194	0.8830
Athletes development	5	0.6546	0.8723	0.9043	0.8675
Sports talent	5	0.7822	0.9319	0.9472	0.9303
Scientific research	3	0.8003	0.8856	0.9232	0.8756
Cultural aspects	6	0.5675	0.8727	0.8868	0.8496

Source: The authors - ADANCO.

tween the hypotheses of the research model. Coaches, infrastructure, science, technology and innovation, and system funding constructs are not significant for the development of athletes. Additionally, system administration, competitions, sports talent and cultural aspects are positively significant for the development of athletes. Hence, hypotheses H4, H5, H6, and H8 are supported.

Cohen f^2 is used to know the change in R^2 when a certain exogenous construct is omitted from the model; that is to say, f^2 may be used for evaluating if the omitted construct has a substantial impact on endogenous constructs. Cohen f^2 values greater than 0.35, 0.15 and 0.02, may be considered as: strong, moderate and acceptable respectively (Cohen, 1988). Cohen f^2 of the routes that support H4, H5, H6, H8 are all greater than 0.02, which proves that the size of these paths' effects is acceptable. The values of t Student with the greatest significance are H4, H5, H6, H8, therefore, these hypotheses are accepted and the precision of the estimates has been confirmed.

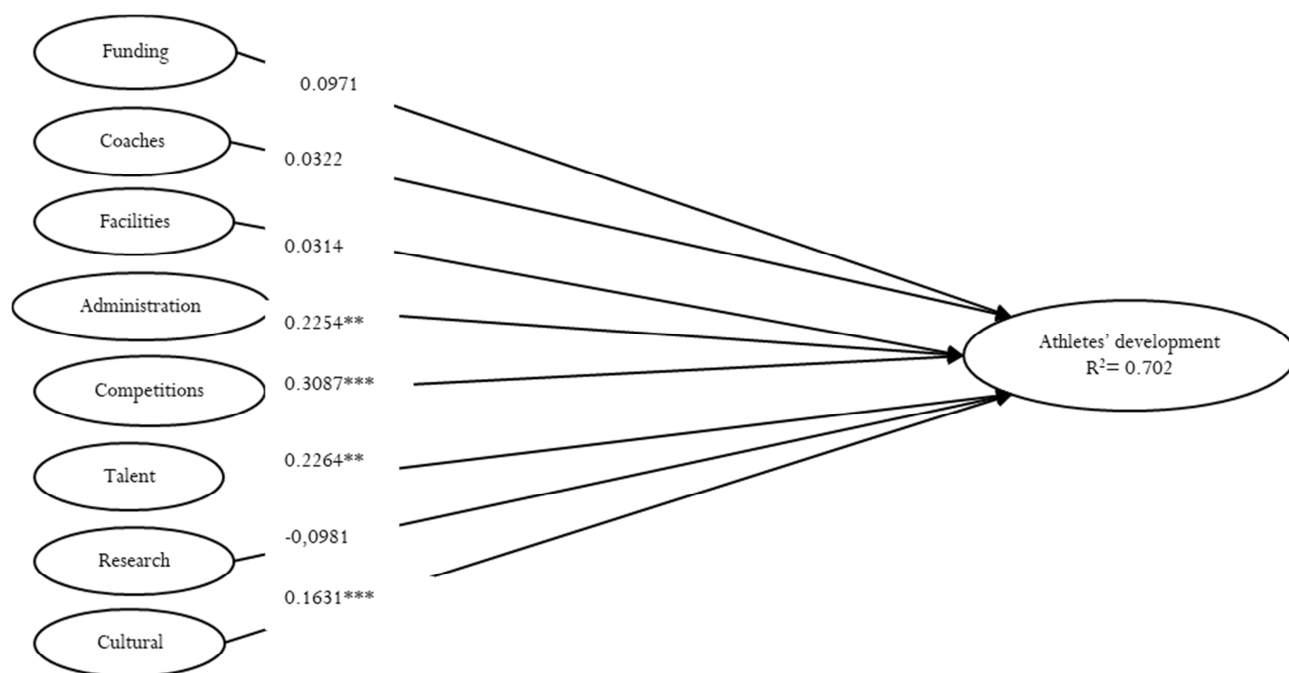


Figure 1. Structural Model. Source: The authors - ADANCO.

Table 5. Structural model and hypotheses tests

Hypotheses	Path β	SE	t- Value	Cohen's f^2	p value	Supported
H1. Elite sports funding \rightarrow Athletes' development	.097	.071	1.360	.012	.174	Not supported
H2. Coaches \rightarrow Athletes' development	.032	.067	.478	.001	.632	Not supported
H3. Sports facilities \rightarrow Athletes' development	.031	.068	.459	.001	.645	Not supported
H4. System administration \rightarrow Athletes' development	.225*	.097	2.305**	.045	.021	Supported
H5. Competitions \rightarrow Athletes' development	.308***	.090	3.395***	.114	.000	Supported
H6. Sports talent \rightarrow Athletes' development	.226**	.074	3.044***	.047	.002	Supported
H7. Scientific research \rightarrow Athletes' development	-0.098	.087	-1.121	.009	.262	Not supported
H8. Cultural aspects \rightarrow Athletes' development	.163**	.053	3.072***	.051	.002	Supported

Note: *t-values: 1.65 (10 %); **t-values: 1.96 (5 %); ***t-values: 2.58 (1 %).

Note: Path β *p<.05; **p<.01; ***p<.001.

Note: Cohen's f^2 : .35 (strong); .15 (moderate); .02 (acceptable).

Discussion

This article explores the phenomenon of elite athletes' development within the context of a developing region, such as Valle del Cauca, Colombia. The study applies a structural equations model, by following partial least square methodology, to test policy factors leading to international sports success. Whilst there is a growing body of literature about elite sports, the mechanisms and conditions under which emerging countries organize their sports system for international sports success remain unexplored. There is a growing demand for evidence-based empirical research on which to base public investment in elite sports (De Rycke et al., 2019).

Previous research suggests that all factors are important for achieving the maximum potential of a sports system (Hopkinson et al., 2018). Thus, the importance perception of direct stakeholders about different policy factors is based upon the limited knowledge on the best practices from other sports systems for promoting elite sports (Digel, 2005). It is also important to acknowledge that research results need to be complemented with a qualitative analysis that enables studying every one of the

factors in greater depth (Henry et al., 2020). However, this study preliminarily contributes to fill this void by presenting an empirical model that enables measuring and analyzing the direct stakeholders' perception on the determining factors for promoting elite sports within a sports system undergoing a consolidation process. Hence, it offers only a tentative, but valuable perception of people regarding the factors that have influenced the development of elite athletes.

In general terms, the results of this study suggest that there are particularities that must be taken into account regarding policy factors that have an influence on the development of elite athletes in the Valle del Cauca region, Colombia. The contribution of the different constructs acquires weighted values for the development of athletes. This is considered to be a theoretical advance, as literature review does not show any evidence of causal analysis defining direct influence in the context of a developing region. Therefore, in the context of the research, only some factors directly influenced this purpose, such as system administration, sports competitions, talent development and cultural aspects.

System administration has had a significant positive in-

fluence on the development of athletes. Factors like the technical and financial performance, the coordination between sports organizations and the administrative structure of the system have contributed with this purpose. According to Shilbury & Ferkins (2020), the results suggest that success in system administration depends largely on aspects related to the articulation of organizations and the political framework in which they operate. The sports organizations, apparently, have a significant impact on the system's performance, which suggests that the principles of the corporate governance make part of their common management practices (Geeraert et al., 2014).

Talent identification and selection is confirmed to have a significantly positive influence on the development of athletes. It is acknowledged that there is an effective system for detecting talent and mechanisms for promoting it towards higher categories. This finding is in line with the results of the research by Côté & Lidor (2013) that suggests that policies and programs focused on the development of talent increase the probability of reaching elite sports success. Other key aspects are the interdisciplinary support schemes and the articulation with educational processes for complementing the comprehensive training of athletes. This empirical result supports the notion that elite sports may become a social mobility instrument for athletes seeking an alternative life project in the long term (Kristiansen & Stensrud, 2020).

The results suggest that the competitions system has a significant positive influence on the development of athletes. Organizing international sports events in the local context has enabled athletes to access high level competitive spaces continuously. Also, participation in international competitions abroad has contributed to enhancing their competitive experience. This finding supports the results of research by De Bosscher et al., (2012), that argue that the improvement in athletes' development is driven by the participation in events with a high internationalization dynamic. This, in addition to the athletes having a local competitive calendar articulated with international calendars, gives them the opportunity to permanently enjoy a highly competitive environment within the national context. This aligns with Truyens et al, (2016) who explains that the good organization of a sports structure allows athletes to access events of a higher competitive level.

One of the most important results from this study is the empirical validation of the significantly positive influence that cultural aspects have on the development of elite athletes in Valle del Cauca, Colombia. This finding is consistent with the proposal by Houlihan (2009) and De Bosscher et al., (2009), who claim that cultural patterns are a relevant factor in driving success in elite sports. The recognition of sports as an important activity for social development and as a mechanism for the promotion of values, added to the role of athletes as role models for children and young people, are characteristics that stand out within the local context and that may contribute to

obtaining successful results at the international level (Sotiriadou et al., 2013).

Tradition and recognition of sports, added to the general interest of people and media, have contributed to consolidate a sports culture that recognizes the social work of the athlete as a role model (Mazzei, 2016). However, according to De Bosscher (2016), these causality claims related to the influence of cultural aspects may only be associated specifically to the context of this study. Therefore, it becomes necessary to continue exploring other sports environments that corroborate it.

The result of this research indicates that there is not a direct relationship between the amount of money invested and sports achievements. In consequence, it is not possible to claim that when there is a higher level of funding and prioritization, there will be better athletes, as this depends on a complex set of factors (De Bosscher et al., 2015; De Bosscher et al., 2018). However, it is necessary to clarify that there are indirect relationships, since factors such as interdisciplinary support, academic incentives, financial support for fulltime dedication to sport and participation in international competitions, among others, require funding.

The positive relationship between coaches', sports facilities, scientific research construct and the development of elite athletes was not confirmed. This finding is consistent with De Bosscher et al., (2009), Smolianov et al., (2014; 2016) and Fernandez Ortega et al., (2021) since aspects related to academic training, fulltime dedication, remuneration, experience, specialization, working conditions for coaches, the balance between guaranteeing public access to sports facilities and developing programs for identifying and perfecting sports talent, the funding of applied research and the development of information systems that allow knowledge transfer among direct stakeholders they must be robust enough to support the preparation and competition processes of elite athletes.

Conclusions

This study developed and empirically tested a theoretical model that aims to predict the key factors that directly influence the development of elite athletes in a developing region according to the perception of direct stakeholders. It was found that system administration, sports competitions, sports talent and cultural aspects were the factors that significantly influenced the development of elite athletes within Valle del Cauca region in Colombia. This result confirms the conclusions of previous literature in sports management, indicating that there is no one way through which countries can develop elite sports success, since it is a phenomenon that responds to a series of intrinsic particularities that characterize a nation.

This research contributes to the field of sports policies for elite sports by introducing a predictive model that enables identifying causal relationships between the different factors determines to be relevant for promoting inter-

national sports success within a developing region. However, the authors acknowledge that it would not be possible to build a fully valid model when attempting to study causality patterns in a complex system that has a great number of variables that cannot be controlled. Despite the limitations of this article, empirical evidence presented offers preliminary answers that allow analyzing the phenomenon of the development of elite athletes in contexts of institutional instability.

Managerial implications for decision and policy-makers are summarized as follows. It is essential to strengthen a governance model that promotes policies for elite sports development (political governance), that creates coordination mechanisms within an organizational network (systemic governance) and that strengthens their capacities and maturity (corporate governance).

Likewise, it is important to attract high-level international events which articulate and potentiate local competitive calendars and promote a highly competitive environment. It is important to consolidate a system for talent identification and development that coordinates physical education, school sports and university sports. Finally, sports culture becomes an intangible asset that legitimates sports as an effective long term social policy and that contributes to the development of the region and the country.

The results show that the new statistics model (PLS) helps to understand the region's perceptions at this particular time, and to advise policy makers and sports leaders on the opinions of the direct stakeholders, rather than leading them towards putting less effort in the development of coaching, facilities and other important conditions of sports development.

Limitations and future research

Although this study provides significant findings about the factors influencing the development of athletes, some limitations remain, which provides possible paths for future research. Firstly, the conclusions of this study are limited to the perception of actors within Valle del Cauca, Colombia. Future research should replicate this study in other regions and other countries, which would allow comparisons across different cultural and economic contexts. Secondly, this is a cross-sectional study, for which does not consider how the system has evolved. Future research should consider carrying out a longitudinal study which compares the development of athletes along different periods of time. Thirdly, in spite of the consideration of several constructs referenced in literature that analyze the development of athletes, it is possible that some factors have been omitted, such as political, socio-economic, socio-demographic, and sports participation aspects. Thus, future research should consider integrating these possible factors in the research model for to enhance its predictive power. Finally, the results of this research are limited to a quantitative approach; therefore, the role of this study is a complement to qualitative methods that have been useful

in the analysis of success factors in elite sports in different countries.

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