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Connection between State Funding and International Sporting Success: The Case of Croatia

Sanela Škorić [*]
Evica Obadić [**]

Abstract: *The aim of this paper is to determine the types and intensity of connection between the amount of state funding for various programmes in sport invested by Croatian Olympic Committee from 2001 until 2016 and international sporting success of Croatian athletes. A connection between 12 independent variables (funds invested in 33 summer Olympic sports (24 individual and 9 team sports) broken down in 8 specific programmes, as well as the number of athletes and coaches in different programmes) and international sporting success was tested using regression analysis. The results show statistically significant logarithm connection between success and total funds invested (ACR=0.160,* ***R^2=0.319****, p=0.001). Additionally, three variables showed linear, eight logarithm and one quadratic type of connection. Applying different regression models contributes to better understanding of connection between the amount and direction of investments in high performance sport and result of those investments in the form of achieved international sporting success.*

Keywords: international sporting success; financial support; COC programmes; state funding

JEL Classification: D71, Z2

Introduction

A significant number of factors contribute to international sporting success of a country and scholars research these factors in attempt to explain the (level of) contribution of each factor. De Bosscher et al. (2006) differentiate between three levels of factors: **macro-level** (wealth of a nation, population, social and cultural context, geographical and climate variations, degree of urbanisation, political system, etc.),

[*] Sanela Škorić is at University o Zagreb Faculty of Kinesiology, Zagreb, CROATIA. Postal address: Horvaćanski zavoj 15, 10000 Zagreb, Croatia. Phone 00385 1 3658 721. Fax: 00385 1 3634 146. E-mail: sanela.skoric@kif.hr
[**] Evica Obadić is at Croatian Olympic Committee

meso-level (state and sport policies and politics including financial support, organizational context of sport, engagement of population in sport programmes through different types of organized participation, availability of sport infrastructure, talent identification, athletes' healthcare, etc.), and **micro-level** (athletes, their genetic qualities, motivation and close environment such as support from parents, friends and coaches). Although factors at all three levels are interrelated, De Bosscher et al. (2006) find that majority of macro and micro-level factors cannot be influenced and changed. On the other hand, meso-level factors such as the amount and effectiveness of high-performance sport[1] funding from public sources, can be changed since they are embedded into sport policies. Despite this, most of the research deals with macro and micro-level factors, and just a handful investigates meso-level factors. This is mainly due to a fact that countries differ in a way they organize and finance their sport systems, which complicates data gathering and analysis (De Bosscher et al., 2006) for the purpose of comparison.

On a macro-level, research results suggest that "both a large population and higher per capita GDP are needed to generate high medal totals." (Bernard & Busse, 2004, p. 413) The starting premises are that larger countries have larger talent pools to choose from, and richer countries can invest more in sport and provide better infrastructure needed to practise sport (Bernard & Busse, 2000; Bernard & Busse, 2004; Grimes et al., 1974; Kiviaho & Mäkelä, 1978; Levine, 1974; Lui & Sen 2008; Morton, 2002). This baseline model was expanded to include variables such as hosting an event, climate conditions, political system, number of female athletes, even corruption or schooling indicators (Andrade Rosas & Flegl, 2019; Andreff, M., Andreff, W. & Poupaux, 2008; Bernard & Busse, 2000; Bernard & Busse, 2004; Forrest et al., 2017; Grimes et al., 1974; Kiviaho & Mäkelä, 1978; Levine, 1974; Lui & Sen 2008; Morton, 2002; Otamendi & Doncel, 2014; Otamendi et al., 2020; Scelles et al., 2020; Soos et al., 2020; Trivedi & Zimmer, 2014; Vagenas & Palaiothodorou, 2019). Due to already mentioned problems with data gathering, variables concerned with finances, such as the level of public expenditure on recreational, cultural, and religious affairs (Blais-Morisset, Boucher & Fortin, 2017; Forrest, Sanz & Tena, 2010) or on health (Vagenas & Vlachokyriakou, 2012) are seldomly used. Also, used in this manner, these variables include expenditure on wider categories and not only on sport which can lead to questionable results. Nevertheless, both variables showed a significant positive impact on medals won at Olympic games in explanatory and prediction models. According to Blais-Morisset, Boucher and Fortin (2017) it seems to be an even better indicator of Olympic performances than GDP per capita, because it is a targeted governmental policy tool (Scelles et al., 2020). In conclusion, wealth of a nation and population size are identified as factors that highly contribute to international sporting success directly or through the size of Olympic team which seems to play the "role of transmitting the composite impact of a country's size and economy to the end-phase of Olympic success." (Vagenas & Vlachokyriakou, 2012). However,

Bernard and Busse (2000) as well as Stamm and Lamprecht (2000 and 2001), find that the importance of these factors is decreasing over time (using macro-level factors authors explained 57% of international sporting success from 1964 until 1980, whereas after 1980 only 45%). It is therefore evident that the importance of other factors is increasing (Gulyás et al., 2016).

Micro-level research mostly deals with positive and negative factors affecting individual athletes' success, such as their motivation (internal and external) and close environment (support from coaches, parents, friends, clubs, federation, state and financial support, etc.). The most important are personal commitment and motivation, support (from society, family, friends), and quality and excellence of coaches (De Knop et al., 2004; Duffy et al., 2001; Gibbons et al., 2003). The main obstacles to sporting success are lack of financial support, conflict with other life roles and lack of coaching expertise or support (Gibbons et al., 2003).

Meso-level research build on assumption that athletes coming from countries which invest more and efficiently in sport development will achieve better international sporting success, i.e. win more medals (Andrade Rosas & Flegl, 2019; De Bosscher et al., 2006). Understanding that sporting success is a complex notion depending on different factors (Robinson & Minikin, 2012), this study is that of the meso-level and analyses the total amount of funds invested by the Republic of Croatia through Croatian Olympic committee (COC) from 2001 until 2016, for financing Olympic sports. The aim of this paper is not to forecast the success of Croatian athletes at different European and World competitions or build on macro-level research, but to research into the relationship between funds invested in different COC funding programmes and international sporting success. The main purpose is to help decision makers to steer the finances towards programmes proved to have a positive effect. Additionally, the amount of the investment is of interest as well. Is there a "limit" to how much money is to be invested in a certain programme, or does every increase/decrease generate increase/decrease in results? To our knowledge, this approach represents a novelty in researching international sporting success. Although targeted approach to investments in elite sport (Sam, 2012) is already discussed in scientific papers, it is mostly done from the point of view of particular sports (Forrest et al., 2017; Jacobs, 2014; Otamendi & Doncel, 2014; Valenti, Scelles & Morrow, 2020) and not different programmes financed by the national governing bodies.

Literature review

Until the year 2000 there has been surprisingly low number of meso-level factors research. One of the main reasons for this might be the fact that "it is unattainable to develop indicators for each and every participating country based on publicly available data." (Otamendi, et al., 2020, p. 671) According to De Bosscher et al. (2006),

majority of research dealt with similarities and differences between nations regarding their sport systems and analysed organizational and management context of elite sport in former communist countries (Houlihan, 1997; Kruger, 1984; Riordan, 1991; Semotiuk, 1990). Some of the research conducted after the year 2000 showed that national elite sport systems are becoming the same, homogenous in every country (Green & Oakley, 2001; Houlihan & Green, 2008), but there is still room to differ among them (Green & Oakley, 2001). Macro-level research also emphasize this conclusion and discuss sport policy when accounting for differences in results (Otamendi, et al., 2020), explain some of the used variables in the research (Forrest et al., 2017) or refer to needed future actions (Otamendi & Doncel, 2014).

Since the national sport systems are becoming very similar (homogenous), last two decades of research have been dedicated to answering the question as to why some countries are more successful than others, and how can state and sport policy creators contribute to enhancing competitive advantage of their athletes, with amount and direction of investments becoming a central issue. One of the most comprehensive research projects dealing with meso-level factors is that of De Bosscher and associates carried out continuously since 2006 (De Bosscher, 2018; De Bosscher et al., 2006, 2009, 2010, 2015). According to those research, international sporting success factors under the jurisdiction of state and sport policy and politics, can be grouped into nine key areas, i.e. pillars. One of those pillars is financial support, which is of interest for this paper. Other pillars are organization and structure of sport policies (an integrated approach to sport policy development), foundation and participation in sport activities, talent identification and development system, athletic and post-career support, training facilities, coaching provision and coach development, (inter) national competition, scientific research. The aim was to contribute to solving the meso-level research problem – the lack of standardized method to measure the competitiveness of nations on elite sport (De Bosscher et al., 2006, 2009, 2010, 2015) to be used in studies for comparison purposes.

In addition to two previously mentioned papers that build on general macro model by introducing financing variables (Forrest, Sanz & Tena, 2010; Blais-Morisset, Boucher & Fortin, 2017), there is only a handful of authors whose studies include public funding from state budgets (government and lottery funds) as a variable. The results of the research conducted in 15 countries (De Bosscher et al., 2015) indicate strong positive relationship between the amount of funds invested in elite sport and international sporting success. Most successful countries largely invested into sport (over 100 million of euros per year) and scored best in pillars 7 (coaching provision and coach development) and 6 (training facilities). Countries wining the most medals in relation to funds invested, scored highly in pillar 2 (an integrated approach to sport policy development). They have strong national coordination of activities, clear decision-making structure, strong involvement of athletes and coaches in policy development, full-time management staff in national sport federations, etc. One of the

conclusions was that more money does not necessarily mean more medals, and that investment increase leads to success up to a certain level (De Bosscher et al., 2015). Four countries encompassed by the research (Australia, France, Finland, and Belgium) increased sport funding from 2001 until 2011, but their share in total medals decreased. The conclusion was that the absolute amount of funding should not be increased indefinitely but up to a certain level when most efficient results are achieved. Although Andrade Rosas and Flegl (2019) rejected the hypothesis that sport funding is reflected by the performance in Rio, they state that Great Britain began investing heavily in sport after Olympic Games in Atlanta 1996, which led to "enormous growth of athlete performance. However, this growth has slowed down and, probably, has already reached its upper bound." (p. 26) Therefore, further spending should remain at the level needed to maintain achieved efficient sport system. Additionally, research findings of De Bosscher et al. (2015) state that efficient nations achieve more success with less investments, successful countries have implemented national strategies for elite sport development, and they rely on controllable (meso-level) and not uncontrollable (macro-level) variables.

Finally, research showed that it is not possible to develop one general model that explains international sporting success (De Bosscher et al., 2015). System that leads to success in one country can be doomed for failure in another. It is emphasized that a specific combination of nine pillars can stand in the context of one nation, and different systems can achieve success in different ways. Since there is no common blueprint for achieving sporting success, each nation must find specific key areas efficient in their case. Money is a prerequisite, but not a guarantee of success, so the central question should be how these funds are spent, which key areas should be targeted so athletes can be successful at international competitions? Recent research on sport funding accentuate a lack of attention being paid to distribution of funding (De Bosscher et al., 2019), a decision which is in the hands of high-performance managers. Strategic allocation of sport budgets between sports is as important as its amount and can explain observed differences in performance at the Olympic games between economically and demographically similar countries (Matros & Namoro, 2004). However, numerous factors (geographical, political, cultural, etc.) influence the decisions on how to determine the priorities in sport funding, and they are different in each country (De Bosscher et al., 2019). Nations have been known to allocate funds in sports that have proven to be more successful in the past and are expected to do the same in the future (Houlihan & Zheng, 2013; Sam, 2012; Weber et al., 2017; Zheng et al., 2018). According to De Bosscher et al. (2019) all 16 countries included in the research used priority funding, and the share of eight most successful sports in total success is greater that the share of funds invested in those sports.

This paper builds on the work of previous research on the topic of state funding for sport (De Bosscher, 2018; De Bosscher et al., 2015) and pilot study conducted by Obadić and Škorić (2019) which is, according to our knowledge, the first in Croatia to

study relationship between allocated state funds into each Olympic sport separately by their purpose, and international sporting success.

Public financing for high-performance sport in Croatia

The system of public financing of sport in Croatia is governed by the law (Sports Act, 2006). Each year state funds for financing the public needs in sport are forwarded to Central State Office for Sports or ministry in charge of sport, which redirects these funds according to their purpose to different national sport governing bodies such as Paralympic committee, Deaf Sports Association, School Sports Federation, Academic Sports Association, and Olympic committee. Public funds for high performance sport are distributed to COC, which then allocates these funds to national federations (associations) (NFs/NAs). These funds are aimed for promoting sport development, looking after the welfare of athletes, organizing preparations and competitions at Olympic games (OG), World (WC) and European (EC) championships and cups, state championships, etc. They are implemented through four key programmes:

1. **NFs'/NAs' regular programmes** (NFs'/NAs' RPs) are programmes that include funds for financing participation of Croatian athletes at various domestic and international competitions, as well as administration and material expenses of NFs/NAs. The highest amount of COC's budget is allocated to this programme.
2. **Development programmes for athletes** (DPs for athletes) ensure achievement of additional (targeted) support for most successful and up-and-coming athletes in both individual and team sports. The emphasis is on development and enhancement of competitive sport results and achievements.
3. **Olympic programme** (OP) represents a four-year (targeted) support to athletes in individual and team sports for successful qualification process and participation at OGs.
4. **Development programmes for coaches** (DPs for coaches) provide funds needed to employ most successful coaches to ensure expert and quality training for top-level athletes.

COC's total budget consists of state funds (more than 87%), and income from other sources such as marketing or IOC (around 13% of the total budget). Both sources will be included in the research. Funds are allocated in coordination with each member of COC (NA/NF and other associations) based on the criteria laid down in internal COC documents with success achieved at OGs, followed by WCs and ECs being the most important criteria. Results achieved at lower rank competitions such as World or European cups, are less valued (Croatian Olympic Committee, 2016; 2018a; 2018b; 2018c).

Methodology and Data

Research encompassed sporting performance by Croatian athletes in 33 summer Olympic sports (24 individual and 9 team sports) from 2001 until 2016 and financed by COC programmes. A connection between financial support for different COC programmes and international sporting success (ISS) measured by achieved ranking from 1st to 8th place at OGs, WCs and ECs was analysed (all variables and their values are presented in Tables 1 and 2). The ISS was calculated using weighted point system in the following manner: 1st place was awarded 8 points, 2nd place 7 points, 3rd place 6 points, 4th place 5 points, 6th place 3 points, 7th place 2 points, and 8th place 1 point. Additionally, points were adjusted according to competition calendar since, depending on the sport, WCs and ECs are held in different time periods (every year, every two or every four years), and OGs are held every four years. Following adjustment coefficients were developed: 1.00 for OGs, WCs and ECs held every four years; 0.50 for WCs and ECs held every two years; and finally 0.25 for WCs and ECs held every year. After multiplying determined adjustment coefficients with weighted points for each sport, final success of Croatian athletes in senior category at OGs, WCs and ECs was calculated.

Table 1: Amounts invested in each sport by programmes in Croatian Kunas

Sport	All programmes	NFs'/NAs' regular programmes (RPs)			Development programmes (DPs)			Olympic programme (OP)
		total	for WC+EC	administrative and material expenses	Total	for athletes	for coaches	
Shooting	41,962.3	28,224.6	9,822.7	7,851.1	6,368.6	1,932.9	4,435.7	7,369.1
Taekwondo	34,739.8	21,853.8	10,326.9	3,031.0	7,363.9	2,780.3	4,583.6	5,522.0
Swimming	48,884.6	30,104.3	19,385.7	6,196.2	8,254.6	2,939.2	5,315.4	10,525.7
Sailing	55,132.7	27,894.2	16,228.4	5,992.9	12,374.9	6,296.5	6,078.4	14,863.5
Kayak-canoe	31,190.8	23,288.6	12,520.5	5,672.1	5,093.5	1,776.9	3,316.6	2,808.7
Athletic	59,136.6	31,257.0	18,354.7	7,275.0	13,855.2	5,946.5	7,908.6	14,024.4
Handball	103,754.0	75,099.1	58,922.7	8,579.5	9,141.7	2,812.9	6,328.8	19,513.2
Rowing	61,234.9	34,135.2	19,684.8	4,552.9	15,277.1	8,576.7	6,700.4	11,822.6
Boxing	17,367.0	12,781.1	5,718.7	3,276.8	2,483.0	198.9	2,284.1	2,102.9
Table tennis	44,748.5	27,858.3	12,686.7	4,226.6	11,354.9	3,450.9	7,903.9	5,535.3
Water polo	63,937.3	39,878.1	22,470.2	6,585.2	8,812.2	2,896.1	5,916.1	15,247.1
Archery	10,032.2	8,046.3	5,017.7	1,755.2	1,985.9	1,365.8	620.1	0.0
Tennis	33,934.1	21,672.3	6,337.2	5,789.2	6,437.2	4,021.7	2,415.5	5,824.6
Wrestling	20,126.3	13,853.1	6,172.9	5,694.8	4,541.7	2,261.6	2,280.1	1,731.6
Gymnastics	21,239.4	11,573.7	4,848.5	2,308.6	7,073.6	2,693.1	4,380.6	2,592.0
Weightlifting	11,289.3	7,431.6	4,985.4	2,114.2	2,789.6	234.7	2,554.9	1,068.1
Basketball	72,589.2	61,858.8	41,758.7	8,479.6	7,650.8	2,778.1	4,872.8	3,079.6
Judo	20,689.3	11,618.8	4,227.1	3,630.7	7,722.8	4,388.0	3,334.9	1,347.6
Softball	4,972.4	4,972.4	3,155.8	699.9	0.0	0.0	0.0	0.0
Triathlon	6,067.7	4,602.9	2,149.7	839.7	1,156.9	554.7	602.3	307.9
Volleyball	33,890.2	29,823.0	20,384.8	5,087.6	4,067.2	1,156.3	2,911.0	0.0
Football	24,304.7	24,304.7	14,208.3	8,423.2	0.0	0.0	0.0	0.0
Long distance swimming	4,495.1	3,395.6	1,294.9	1,105.6	903.0	555.3	347.7	196.5
Baseball	5,478.7	5,478.7	3,572.1	928.5	0.0	0.0	0.0	0.0
Fencing	8,277.5	6,613.4	2,781.8	1,946.0	1,535.2	250.1	1,285.1	128.9
Rugby	12,731.8	11,880.6	8,177.5	2,864.6	851.3	0.0	851.3	0.0
Badminton	7,681.1	3,982.7	1,323.8	1,042.2	2,693.4	2,011.2	682.2	1,005.1
Cycling	10,468.4	8,159.1	4,169.6	3,136.3	639.3	134.2	505.1	1,670.0
Golf	2,068.6	2,047.2	90.7	224.9	21.4	21.4	0.0	0.0
Field hockey	8,224.7	7,443.9	3,216.6	2,166.1	780.8	0.0	780.8	0.0
Equestrian	6,062.6	5,238.2	1,133.1	2,011.4	814.1	0.0	814.1	10.3
Synchronized swimming	3,742.0	3,133.5	1,512.8	882.7	608.4	0.0	608.4	0.0
Diving	4,784.2	3,451.4	1,317.1	1,519.9	1,275.3	399.8	875.6	57.5
Totally OG 2001-2016	895,237.8	612,955.9	347,958.1	125,890.2	153,927.7	62,433.7	91,494.0	128,354.2

Note: NF – national federation; NA – national association; WC – World championship; EC – European championship

Source: authors' calculations according to internal COC data (2001 – 2016)

Table 2: Number of athletes, coaches and calculated ISS

Sport	Number of athletes			Number of coaches in DPs (n)	Calculated ISS	
	total (n)	in DPs (n)	in OP (n)		In points	Rank
Shooting	169	100	69	32	339.00	1
Taekwondo	248	164	84	30	311.50	2
Swimming	241	140	101	33	284.50	3
Sailing	296	195	101	37	189.00	4
Kayak-canoe	119	89	30	21	175.75	5
Athletic	364	226	138	43	158.50	6
Handball	348	171	177	35	104.50	7
Rowing	422	324	98	37	87.25	8
Boxing	64	23	41	15	63.00	9
Table tennis	180	130	50	42	57.00	10
Water polo	318	172	146	39	56.50	11
Archery	47	47	0	6	54.25	12
Tennis	213	140	73	22	38.75	13
Wrestling	128	102	26	22	33.25	14
Gymnastics	138	117	21	29	30.25	15
Weightlifting	20	11	9	16	20.50	16
Basketball	169	157	12	35	16.50	17
Judo	231	208	23	28	11.25	18
Softball	0	0	0	0	9.50	19
Triathlon	25	22	3	8	8.75	20
Volleyball	34	34	0	23	8.50	21
Football	0	0	0	0	4.00	22
Long distance swimming	34	30	4	5	1.50	23
Baseball	0	0	0	0	1.00	24
Fencing	17	16	1	15	1.00	25
Rugby	0	0	0	9	0.25	26
Badminton	88	88	0	9	0.00	
Cycling	30	7	23	6	0.00	
Golf	3	3	0	0	0.00	
Field hockey	0	0	0	9	0.00	
Equestrian	4	0	4	9	0.00	
Synchronized swimming	0	0	0	8	0.00	
Diving	38	37	1	11	0.00	

Notes: rank was calculated by multiplying ISS in points by determined adjustment coefficients; ISS – international sporting success; DP – development programmes; OP – Olympic programme

Data on financial support was gathered from COC's financial reports and internal documents. To deal with inflation problems (Horgan and Norton, 2000), real amounts were calculated using Eurostat's HPCI (Harmonizes Consumer Price Index) for Croatia from 2001 until 2016. Microsoft Excel 365 and IBM SPSS Statistics 25 were

used for data analysis. Basic descriptive parameters (sum (∑), arithmetic mean (AM), standard deviation (SD), absolute (N) and relative (%) frequencies) and normality of distribution were calculated for each variable (Table 3). Statistical significance of deviation from normal distribution was determined by Shapiro-Wilk's test ($p < 0.05$) (Royston, 1992).

Table 3: Descriptive statistics of 33 observed sports (national federations/associations)

Variables	AM±SD	Normal distribution	Shapiro-Wilk P[1]
All programmes (KN)	27,128,419±24,884,781	No	0.001
NFs'/NAs' RPs (KN)	18,574,423±17,000,106	No	0.000
RPs (for WC + EC) (KN)	10,544,185±12,367,122	No	0.000
RPs (administrative and material expenses) (KN)	3,814,855±2,592,663	No	0.019
DPs (KN)	4,664,477±4,403,161	No	0.002
DPs for athletes (KN)	1,891,930±2,133,297	No	0.000
DPs for coaches (KN)	2,772,546±2,499,142	No	0.003
OP (KN)	3,889,520±5,505,552	No	0.000
Number of athletes (n)	121±127	No	0.001
Number of athletes in OP (n)	37±50	No	0.000
Number of athletes in DPs for athletes (n)	83±85	No	0.001
Number of coaches in DPs for coaches (n)	19±14	No	0.024
ISS at OG+WC+EC (points)	63±96	No	0.000

[1] Shapiro-Wilk p value lower than 0.05 implies that data is not normally distributed

Note: KN – Croatian Kunas; AM – arithmetic mean; SD – standard deviation; NF – national federation; NA – national association; RP – regular programme; WC – World championship; EC – European championship; DP – development programme; OP – Olympic programme

A series of simple linear (Yan & Gang Su, 2009) and non-linear (Seber & Wild, 2005) regression analysis were conducted to test the relationship between 12 independent variables and ISS. Non-linear models were also used because the connections between variables pointed to a non-linear relationship. Additionally, since the population consisted of only 33 Olympic sports, the adequacy of the model was determined with the accuracy-complexity ratio (ACR). The higher the ratio, the model is more adequate for generalization, i.e., the model having the highest ACR best explains the results. ACR is calculated by dividing the determination coefficient by the number of constant variables (b_0) and the number of weights ($b_1, b_2, \ldots b_n$):

$$ACR = \frac{R^2}{(b_0 + b_1 + b_2 + ... + b_n)}$$

ACR – accuracy-complexity ratio
R^2 – determination coefficient
b_0 – model constant
$b_1, b_2, \ldots b_n$ – model weights

Determination coefficient (R^2) for linear, logarithmic, and inverse regression was divided by 2, for quadratic by 3, and cube by 4. ACR value equal or higher than 0.3 is considered acceptable for the predictions, and lower than that implies a correlation that is too weak in relation to model complexity, even though they may be statistically significant ($p < 0.05$). In terms of R^2 values, those would be: $R^2 = 0.6$ for the linear, logarithmic, and inverse regression, $R^2 = 0.9$ for quadratic, and $R^2 = 0.99$ for cubic regression. The reason for this complexity-adjusted R^2 is that more complex models will have inflated R^2. this phenomenon is called Ockham's razor (Sober, 2015).

Results

Based on previously explained steps, the results of a series of linear and non-linear simple regressions are presented in Table 4.

Table 4: Regression analysis results

		All programmes	NFs'/ NAs' RPs	RPs (for WC+EC)	RPs (admins. and mater. expenses)	DPs (total)	DPs for athletes	DPs for coaches	OP	Number of athletes (DPs + OP)	Number of athletes in OP	Number of athletes in DPs for athletes	Number of coaches in DPs for coaches
Linear regression	R^2	0.237	0.152	0.080	**0.228**	**0.261**	0.109	0.296	0.243	0.253	0.273	0.151	**0.295**
	p	0.004	0.025	0.111	**0.005**	**0.004**	0.099	0.002	0.014	0.007	0.011	0.050	**0.002**
	ACR	0.119	0.076	/	**0.114**	**0.131**	/	0.148	0.122	0.127	0.137	0.076	**0.148**
Logarithmic regression	R^2	**0.319**	**0.274**	**0.198**	0.219	0.241	**0.169**	**0.321**	0.312	**0.273**	**0.354**	**0.204**	0.291
	p	**0.001**	**0.002**	**0.009**	0.006	0.006	**0.037**	**0.001**	0.005	**0.005**	**0.003**	**0.020**	0.003
	ACR	**0.160**	**0.137**	**0.099**	0.110	0.121	**0.085**	**0.161**	0.156	**0.137**	**0.177**	**0.102**	0.146
Inverse regression	R^2	0.201	0.220	0.031	0.089	0.025	0.051	0.241	0.053	0.093	0.149	0.097	0.236
	p	0.009	0.006	0.331	0.092	0.400	0.269	0.007	0.281	0.121	0.069	0.122	0.008
	ACR	0.101	0.110	/	/	/	/	0.121	/	/	/	/	0.118
Quadratic regression	R^2	0.389	0.354	0.236	0.255	0.335	0.181	0.372	**0.494**	0.348	0.514	0.241	0.314
	p	0.001	0.001	0.018	0.012	0.004	0.100	0.002	**0.001**	0.006	0.001	0.042	0.007
	ACR	0.130	0.118	0.079	0.085	0.112	/	0.124	**0.165**	0.116	0.171	0.080	0.105
Cubic regression	R^2					0.335	0.191	0.408	0.505	0.357	0.515	0.245	0.374
	p					0.130	0.190	0.004	0.002	0.016	0.003	0.097	0.008
	ACR					/	/	0.102	0.126	0.089	0.129	/	0.094

Note: ACR – accuracy-complexity ratio; p – p-value; R^2 – determination coefficient; NF – national federation; NA – national association; RP – regular programme; WC – World championship; EC – European championship; RP – regular programme; DP – development programme; OP – Olympic programme

Bolded are values that best explain the connection between variables observed and ISS based on ACR value. ACR was not calculated for regressions not statistically significant ($p < 0.05$)

Based on ACR values, the results show that each of the analysed 12 independent variables is connected with ISS of Croatian athletes at OGs, WCs and ECs, but in different ways:

- A logarithmic type of connection was determined for 8 variables (*Number of athletes in OP; DPs for coaches; All programmes; NFs'/NAs' RPs; Number of athletes (DPs+OP); Number of athletes in DPs for athletes; RPs (for WC+EC); DPs for athletes*),
- 3 showed linear (*Number of coaches in DPs for coaches; DPs (athletes and coaches); RPs (administrative and material expenses*)), and
- 1 quadratic type of connection (*OP*).

Discussion

Previous research studied the relationship between international sporting success and different economic, demographic, political and sport connected predictors of that success (Andreff, 2009; De Bosscher, 2018; De Bosscher et al., 2006, 2009, 2010, 2015; Gulyás et al., 2016; Matros & Namoro, 2004). The results show that the relationship between mentioned predictors and international sporting success is not only simple and linear, but can be single and multiple, as well as linear and non-linear. This was the main assumption of this this paper as well, so several different possible relationships were analysed. The results are presented in Table 4 showing both linear and non-linear (logarithmic and quadratic) relationships, and are in line with previous research (Andreff, 2009; De Bosscher, 2018; De Bosscher et al., 2006, 2009, 2010, 2015; Gulyás et al., 2016; Matros & Namoro, 2004). Nevertheless, it should be noted that previous studies did not research this matter in the same way, i.e. total funds were not broken down into different categories (funds spent for different programmes, purposes). This paper used as variables both total amounts, and funds for different programmes, which makes it a novelty. Nevertheless, it should be noted that presented programmes are specific for COC, and it is possible other Olympic committees do not use the same classification.

The main finding of the research is that state funding correlates with international sporting success, since variable *All programmes* showed statistically significant connection with ISS of Croatian athletes at OGs, WCs and ECs (in points) (ACR =0.160, $\boldsymbol{R^2=0.319}$, p=0.001), which is in line with the results of other studies (De Bosscher, 2018; De Bosscher et al., 2006, 2009, 2015; Obadić & Škorić, 2019). Additionally, this connection was best explained by logarithmic model confirming the notion that the absolute amount of funding should not be increased indefinitely but up to a certain level when most efficient results are achieved. This is in line with De Bosscher et al. (2015) results for Australia, France, Finland, and Belgium, and Andrade Rosas and Flegl (2019) results for Great Britain. The fact that there seems to be a limit as

Table 5: Recommendations

[a]Rank	Variable	Type of connection	[b]Strength (R^2)	p	ACR	Recommendation
1.	Number of coaches in DPs for coaches (n)	Linear	0.295	0.002	0.148	Significant increase
2.	DPs (total) (KN)	Linear	0.261	0.004	0.131	Significant increase
3.	RPs (administrative and material expenses) (KN)	Linear	0.228	0.005	0.114	Significant increase
4.	Number of athletes in OP (n)	Logarithmic	0.354	0.003	0.177	Moderate increase
5.	DPs for coaches (KN)	Logarithmic	0.321	0.001	0.161	Moderate increase
6.	All programmes (KN)	Logarithmic	0.319	0.001	0.160	Moderate increase
7.	NFs'/NAs' RPs (KN)	Logarithmic	0.274	0.002	0.137	Moderate increase
8.	Number of athletes (total) (n)	Logarithmic	0.273	0.005	0.137	Moderate increase
9.	Number of athletes in DPs for athletes (n)	Logarithmic	0.204	0.020	0.102	Moderate increase
10.	RPs (for WC+EC) (KN)	Logarithmic	0.198	0.009	0.099	Moderate increase
11.	DPs for athletes (KN)	Logarithmic	0.169	0.037	0.085	Moderate increase
12.	OP (KN)	Quadratic	0.494	0.001	0.165	Increase until 11 mil. KN, decrease for amounts over 11 mil. KN

[a]Rank implies the rank of importance of the variable for the ISS of Croatian athletes at OGs, WCs and ECs (expressed in points) according to expected contribution of the variable to overall success. Variable which holds rank 1 refers to a variable whose value (financial amount) should be increased mostly, followed by those implying lesser and lesser increase. The rank was composed based on the type and the strength of the connection (R^2). Type of the connection was first factor to determine the rank (first linear, then logarithmic, and finally quadratic) followed by the strength of the connection (highest R^2 first).

[b]Although different interpretations of R^2 exist, this paper uses the one of Cohen (1988): R^2 below 0.09 defines weak connection, R^2 between 0.09 and 0.25 moderate connection, and R^2 higher than 0.25 strong connection.

to how much money should be directed towards high performance sport raises two questions: what is that limit, and what should that money be used for? Since the decision on the absolute amount of public funds directed towards sport is in the hands of governments and, perhaps contrary to expectations, it is probably more related to the government sporting and economic policy rather than to the level of economic development (Andreff, 2009, p. 9), addressing the issue of directing the funds seems more eligible for discussion. Nevertheless, the ways of determining the priorities in sport funding are different in each country (De Bosscher et al., 2019), so each country must think of its own ways to increase competitive advantage for their athletes. This can be achieved by directing funds into certain sports, or specific programmes and activities as discussed in this paper. Based on regression results certain recommendations as to future management of funds for high performance sport are given in Table 5.

A closer look at four main programmes reveals that three of them (*DPs for coaches*, *NFs'/NAs' RPs*, and *DPs for athletes*) show logarithmic and one (*OP*) quadratic type of connection with ISS of Croatian athletes at OGs, WCs and ECs. Only *DPs for athletes* shows moderate and the rest of programmes reveal strong connection with ISS, with the strongest connection for variables *OP* (R^2=0.494) and *DP for coaches* (R^2=0.321). It should be noted that these two programmes received "only" 10 and 14 % of total funds respectively. In comparison, around 68 % of total funds were received by the programme *NF's/NA's RPs* (612.955.900,00 KN), confirming the conclusion that that money by itself does not guarantee success (De Boscher et al., 2015). By adding up the two *DPs* (for athletes and coaches) a new variable was created (total amount of funds invested in development programmes) which showed a strong linear connection with ISS. A somewhat different situation was for programme *NF's/NA's RPs* showing strong and logarithmic type of connection, but when divided the connection becomes moderate and linear for *RPs (administrative and material expenses)*. This could be explained by the fact that administrative and material expenses (21 % of *NF's/NA's RPs*) present proportionally variable type of costs. Its amount greatly depends on the number of staff, and an increase in staff leads to proportional increase in these funds. On the other hand, funds for world and European championships (57 % of *NF's/NA's RPs*) appear if athletes in certain sport qualify for these competitions making them more volatile. Programme *OP* showed quadratic connection with ISS (ACR=0.165, ***R^2=0.494***, p=0.165), indicating that sports receiving higher amounts of funds in this programme achieved greater success, but up to an amount of 11 million of KN. For sports which received higher amounts, an inversely proportional connection can be noticed, meaning that they achieved lower success. Possible explanation for this could be in specific characteristics of each sport, since some of them need less, and others more money. Some individual sports require greater amounts opposed to other individual sports, whilst team sports need even greater amounts than any individual sport. Additionally, an issue to be considered in future research is the one of different possibilities for achieving success in team versus individual sports.

Individual sports have more disciplines and therefore greater opportunities to win more medals which was not accounted for in this research.

With these conclusions in mind and followed by the fact that research have shown the need to increase absolute amounts of funds only up to a certain (most efficient) level (De Boscher et al., 2015), a recommendation towards creating financing models for team and individual sports separately, and "cheaper" and "expensive" ones, is given. This would help determine the most efficient level of investment for each specific sport group.

Finally, sports having greater number of coaches in *DPs for coaches* (ACR=0.148, ***R^2=0.295***, p=0.002), higher amounts of support in *DPs (athletes and coaches)* (ACR=0.131, ***R^2=0.261***, p=0.004) and *RP (administrative and material expenses)* (ACR=0.114, ***R^2=0.228,*** p=0.005), achieved greater ISS, and each increase in their value led to the same increase in achieved ISS. If COC wants to contribute to better sporting performance of Croatian athletes at OGs, WCs and ECs, a significant increase in these variables is recommended. Since one of the key factors for achieving sporting success are expert managers (De Bosscher et al., 2015) and coaches, increase in the funds aimed for administrative and material expenses should be through increase in the number of personnel (managers and coaches) in NFs/NAs. Their education, development and full-time employment is of utmost importance (Clumpner, 1994; Dawson & Phillips, 2012; De Bosscher et al., 2015). It would therefore be advisable to direct the funds into programmes showing linear connection with ISS, and to find ways to structurally improve programmes showing weakest connection.

Conclusion

The main goal of this paper was to research into the connection between the amount of state funding for different programmes in high performance sport in Croatia and international sporting success of Croatian athletes (earned rankings from 1st until 8th place at Olympic games, World championships and European championships) from 2001 to 2016. To our knowledge this approach of studying funding programmes represents a novelty, but at the same time could be interpreted as the main shortcoming of the paper since the types and structure of these programmes might vary in different countries. Nevertheless, despite the programmes being specific to Croatia, they may have some degree of similarity with other countries and hence, the results may have a certain degree of generalisation.

In total twelve variables were analysed by means of linear and non-linear simple regression, and as a result, three variables showed linear, eight logarithm and one quadratic type of connection. There is a statistically significant logarithm connection between international sporting success and total funds invested. Looking into key programmes, the strongest connection with success is shown for variable *Olympic programme* and *Development programmes for coaches*, the two programmes that re-

ceived about 24 % of all funds invested. Since programme (*NFs'/NAs' RPs*) receiving highest amount of total funds (68 %) showed somewhat weaker connection, it seems the conclusion that money by itself does not guarantee success is supported.

Based on the research results, recommendations go towards significant increase in variables showing linear types of connection (number of coaches in development programmes, funding for all development programmes and NFs'/NAs' administrative and material expenses). Moderate increase is recommended for variables showing logarithm type of connection, and increase up to a certain amount for funds invested in Olympic programme which showed quadratic type of connection.

Croatia is not a wealthy nor heavily populated nation, it is therefore advisable to build its comparative advantage on efficient sport policy based on continuous tracking of relationship between different COC support programmes and international sporting success of Croatian athletes.

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NOTES

[1] As noted by McAuly, Baker and Kelly (2021) there are considerable variations in how academics and practitioners use term "elite" sports and call for greater transparency in describing samples. Since it is widely used to describe "higher performing athletes", this paper builds on that assumption and uses the term high-performance sport indicating all athletes included in financing scheme of Croatian Olympic Committee (COC) through different programmes. Those are athletes fulfilling all necessary conditions (primarily achieved sport results) to participate at different state as well as international competitions. Nevertheless, the term "elite sport" will appear in text as well, especially in literature review chapter as a reference to other papers.

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