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Science of Gymnastics Journal (ScGYM®)

Science of Gymnastics Journal (ScGYM®) (abrevated for citation is SCI GYMNASTICS J) is an international journal that provide a wide range of scientific information specific to gymnastics. The journal is publishing both empirical and theoretical contributions related to gymnastics from the natural, social and human sciences. It is aimed at enhancing gymnastics knowledge (theoretical and practical) based on research and scientific methodology. We welcome articles concerned with performance analysis, judges' analysis, biomechanical analysis of gymnastics elements, medical analysis in gymnastics, pedagogical analysis related to gymnastics, biographies of important gymnastics personalities and other historical analysis, social aspects of gymnastics, motor learning and motor control in gymnastics, methodology of learning gymnastics elements, etc. Manuscripts based on quality research and comprehensive research reviews will also be considered for publication. The journal welcomes papers from all types of research paradigms.

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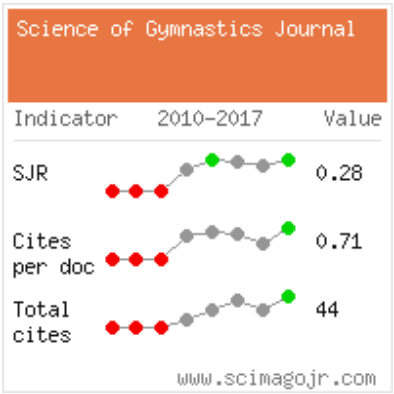

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EDITORIAL

GYMNASTICS AT OLYMPIC GAMES

In 2018, The Science of Gymnastics Journal has reached the first decade of existence! We must celebrate, as it is among the few scientific journals specific to one sport!

We applaud its 10th anniversary with this special issue for October: Gymnastics at Olympic Games.

Rio 2016 has gone, with many memories to recall, the exuberance performance of Simone Biles and Kohei Uchimura in women's and men's Artistic Gymnastics; Margarita Mamun in Rhythmic Gymnastics; and Uladzislau Hancharou and Rosanna Maclennan in women's and men's Trampoline. They were crowned absolute queens and kings, although there are many others who exhibited their best too.

Gymnastics has been growing and evolving at each Olympic Cycle, new skills and combinations abound, and gymnasts seem to have no limits!

However, this evolutionary trend in Gymnastics is partly owed to the science, and the gymnastics' community knows well gymnasts could not reach that far without the support of science.

This special edition adds 12 articles to the science of gymnastics from researchers of Brazil, Bosnia and Herzegovina, Croatia, Germany, Portugal, Slovenia and the United States of America, who cover a variety of topics.

Maja Pajek discusses the influence of rules' changes on the trend of higher difficulties and gymnasts' specialization in Artistic Gymnastics, while investigating the performance of all-around medalists at individual apparatus finals.

Ivan Čuk and Karmen Šibanc present the history of the development of Olympic Games all-around medallists and their success in reaching the podium on individual apparatus in Men's Artistic Gymnastics.

Ivana Montandon and Myrian Nunomura explored the experiences of older gymnasts (over 20 years of age) and the factors that contributed to the prolongation of their sports career in the high level of Women's Artistic Gymnastics in Portugal.

William Sands, Steven Murray, Jeni McNeal, Cindy Slater, and Michael Stone conducted an extended and updated analysis of the sizes trends of U.S. female Olympic artistic gymnasts including the 2012 and 2016 Olympic Games.

Flavio Bessi and Jan Pfeifer attempt to set a viable classification system to categorize the rotation habits of high-level artistic gymnasts in the Women's Individual All Around finalists at the Olympic Games Rio 2016.

Catarina Leandro analyzed the evolution of the apparatus difficulty in the Rhythmic Gymnastics in two Olympic cycles, as an attempt to identify eventual factors that could contribute to the improvement of performance in competition.

Eliana Toledo, Mateus Oliveira, Maria Letícia Scarabelim and Bianca Assumpção analyzed the impact of the Rhythmic Gymnastics Code of Points (2013-2016) by allowing vocal music in routines, at the Rio 2016 Olympic Games.

Laurita Schiavon and Bruna Locci analyzed the perspectives of Brazilian gymnasts on the experience of participating in the Olympic Games in the Women's Artistic Gymnastics competition (1980-2004), using oral history in a qualitative research approach.

Caroline Molinari, Vitor Costa, Kamau Monteiro and Myrian Nunomura analyzed the Brazilian Women's Artistic Gymnastics team participation over the last four cycles (2004-2016) in order to identify and discuss the factors associated to the results and contributions to the development of this sport in the country.

Marco Bortoleto, Paulo Carrara and Murilo Roveri analyzed the participation of the Brazilian trampoline gymnastics in the main international events as the World Championships and the Olympic Games.

William Sands and Olyvia Donti characterized and analyzed the durations of careers of U.S. elite female gymnasts who had qualified for Olympic Games and World Championships teams and compare these with the team rank from 1936 to 2016.

Sunčica Delaš Kalinski, Petra Mandić Jelaska and Almir Atiković examined the relative age effect (RAE) among Women's and Men's Artistic Gymnastics in the elite international gymnasts who competed at Olympic Games.

After hosting the Olympic Games in our country (Brazil), we are very pleased as guest editors for this special issue. It was a unique opportunity to work with researchers from different countries and fields of study, and to realize how science can support the many gaps still to fulfil in the world of gymnastics. Articles also incited our reflection and foster much thought.

We hope you will enjoy every article presented as we did.

Special Guest Editors:

Laurita Marconi Schiavon

Myrian Nunomura

INDIVIDUAL APPARATUS RESULTS OF FEMALE ALL AROUND OLYMPIC CHAMPIONS

Maja Pajek

University of Ljubljana, Faculty of Sport, Slovenia

Original article

Abstract

The changes of Code of Points stimulate the rise in exercise difficulty and a drive towards increased specialization of gymnasts. We inspected the performance of all-around medalists at individual apparatus finals to analyze the trends in their efficiency to reach the podium. Data from Olympic games 1952-2016 was included in this retrospective study. In the period form 1952-1984 there were 5 occasions when all-round winners reached 75 to 100% efficiency in reaching the podium at all individual apparatus finals. However overall, there is a clear trend of diminished efficiency of all-around winners to reach the podium at individual finals in the observed period (1952-2016) from the average of 7.7 medals in the first three observed events to 4.3 medals at the last three observed events. Olympic all-around champion efficiency was calculated from sum of all medals won by all-around champions on apparatuses divided by 4. This efficiency has decreased from 91.7% in the first three events to 41.7% in the last three events. In recent events all-around champions still managed to win at least one medal on single apparatuses as there was only one exception to this rule at 2012. It is very much probable that in the future all-around champions will excel further at single apparatus finals; however a huge predominance of all-around champions at apparatus finals cannot be expected any more.

Key words: *history, artistic gymnastics, development.*

INTRODUCTION

The Olympic Games (OG) are a major international multi – sport event. Becoming an Olympic champion is a dream of many elite athletes. Many years of practice are needed to achieve the top level performance in gymnastics. It takes around 10 000 working hours or minimum of 10 years to achieve the Olympic quality (Arkaev & Suchilin, 2004; Ericsson, Charness, Feltovich and Hoffman, 2006; Gladwell, 2008; Malina, 2010; Fink & Hofmann, 2015; Fink, Hofmann, & Ortiz Lopez, 2015). But, unfortunately, top level performance may not be enough to become an Olympic champion; during the history of OG, some boycotts due to political issues were executed, that prevented top level athletes to compete and also the OG competition regulations became more demanding. Nevertheless, being the Olympic champion is still regarded as the biggest achievement of every athlete.

Artistic gymnastics is one of the disciplines that have always featured the Olympic program (Wallechinsky, & Loucky, 2012). Female gymnastics made its first appearance at OG in Amsterdam, 1928, with a team event. Only a team exercise with rhythmic apparatus and one exercise on chosen apparatus was allowed. Women competed in suits and only male judges were allowed to judge (Bučar, 1998). Women's artistic gymnastics was not staged in 1932 but it reappeared in 1936 (Topends sports, 2018). In 1933 female technical committee was founded and it governs the development of female artistic gymnastics ever since. Its rules were summarized in the Code of Points (COP) (Bučar, 1998). In 1952 at OG in Helsinki female program expanded to seven events and in Rome, 1960, gained its final form of six events (Wallechinsky, & Loucky, 2012): team competition, all around and four apparatus disciplines – vault, uneven bars, balance beam and floor.

In the 1950s and 1960s COP focused on artistry and was largely inspired by ballet (Atiković, Delaš Kalinski, & Smajlović, 2017; Atiković, Delaš Kalinski, & Čuk, 2017). At that time Larysa Latynina (Russia, ex – Soviet Union) and Vera Časlavska (Czech, ex – Czechoslovakia) dominated the women artistic gymnastics (Wallechinsky, & Loucky, 2012). Since then artistic gymnastics became more demanding in terms of complexity and difficulty of elements. It was not only enough to perform higher, faster and stronger elements, but the technical execution of elements gained crucial impact as well (Zurc, 2017). Increments in element difficulty were paralleled by the rise of precision of judging and its regulation (Čuk, & Atiković, 2009; Čuk, & Forbes, 2010; Bučar Pajek, Forbes, Pajek, Leskošek, & Čuk, 2011; Bučar Pajek, Čuk, Pajek, Karácsony & Leskošek, 2012; Bučar Pajek, Čuk, Pajek, Kovač, & Leskošek, 2013; Delaš Kalinski, Atiković, Jelaska, & Milić, 2016). Changes of COP occured from one Olympic cycle to another with a strong influence on artistic gymnastics development. In the period from 1952 to 1996 gymnasts had to perform two routines on each apparatus – a compulsory and an optional one. Until 2006, upper limit of the score was set to a fixed number (mostly up to 10.0 points). From 2006 on, exercises are being evaluated upon open-end score: the content and the exercise difficulty determine gymnast's theoretical maximum score (FIG, 2006).

These changes stimulated a general rise in exercise difficulty and could have been a driver towards increased specialization of gymnasts. From this point of view, it would be useful to inspect the performance of all-around medalists at individual apparatuses to analyze the historical perspective of competitors that excel as all-around performers. Such an analysis would also help to predict the future developments of this sport. Aim of our research was therefore set to analyze the timely trends of success of all-round medalists at individual apparatuses at the OG.

METHODS

We collected all data on OG results from Wallechinsky, & Loucky, 2012 and from gymnasticsresults.com in the period from OG 1952 up to OG 2016. We included following variables at each OG: number of participants, number of participant nations, identity of any gymnast that won a medal at all-around competition and individual apparatuses, sum of all medals won by all-around medalists, sum of gold medals won by all-around medalists, sum of silver medals won by all-around medalists, sum of bronze-medals won by all around medalists, sum of all medals won by the all-around medalists (excluding team medals) on individual apparatuses (three all-around medalists could get 12 medals at individual apparatuses in total, as each all-around medalist can earn maximum 4 apparatus medals). With this sum of medals, we calculated Olympic all-around champion efficiency (all individual apparatus medals of all-around winners divided by 4). We also determined which all-around champions earned most apparatus medals.

RESULTS

Results are showed in Figures and Tables. In first five Figures number of gymnasts and nations at Olympic games qualifications at all around competitions, vault, uneven bars, balance beam and floor are shown.

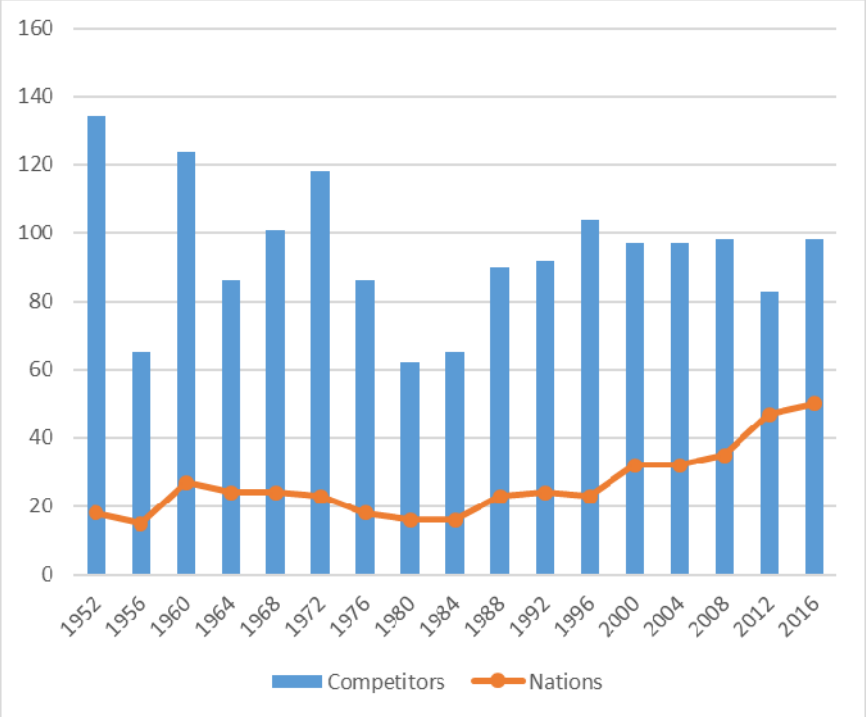

Figure 1. Number of gymnasts and nations at Olympic games in all-around qualifications.

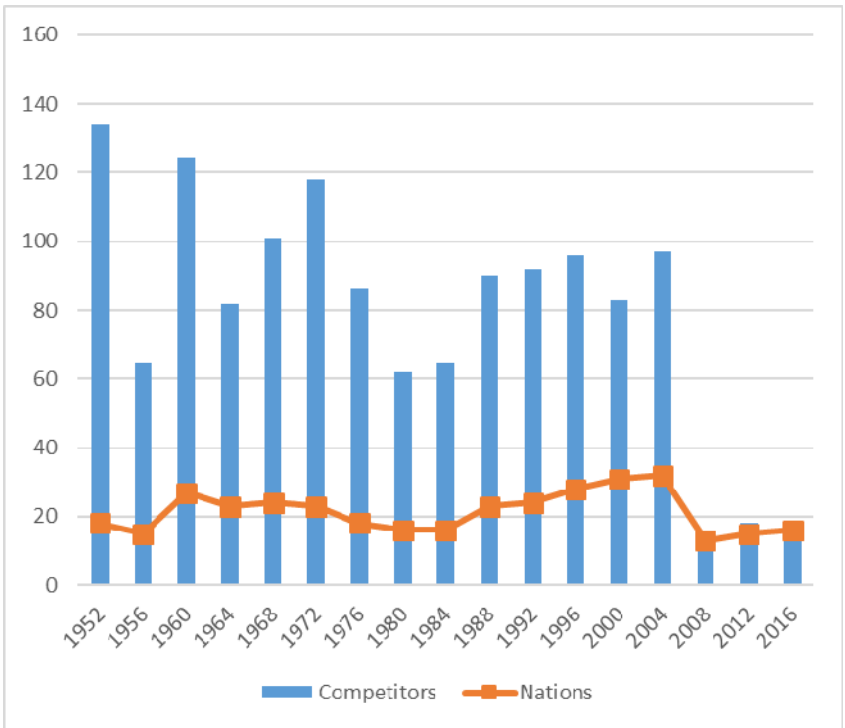

Figure 2. Number of gymnasts and nations at Olympic games on vault qualifications.

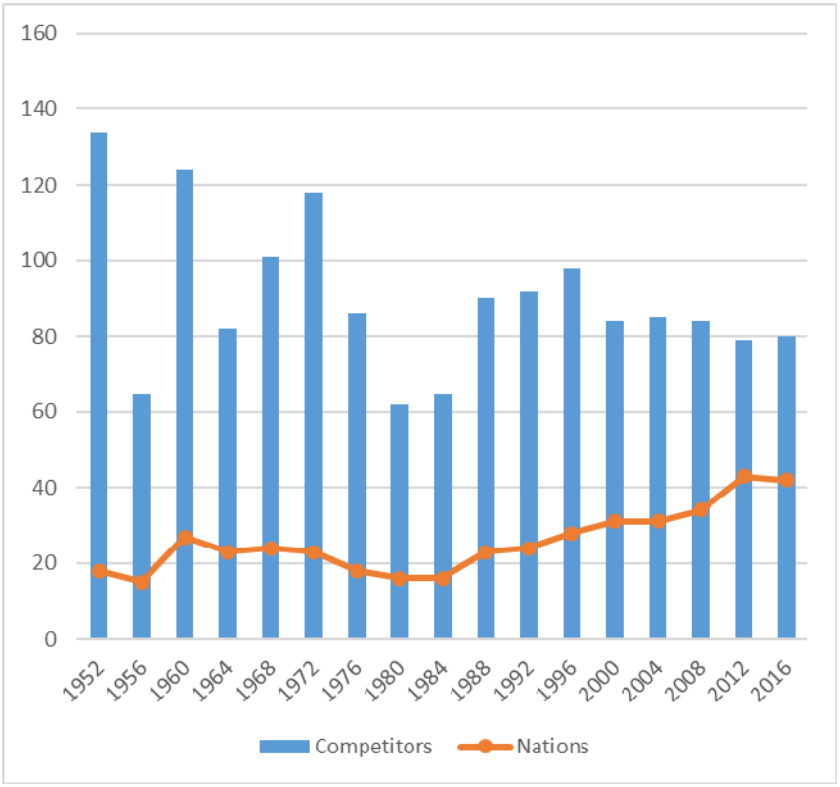

Figure 3. Number of gymnasts and nations at Olympic games on uneven bars qualifications.

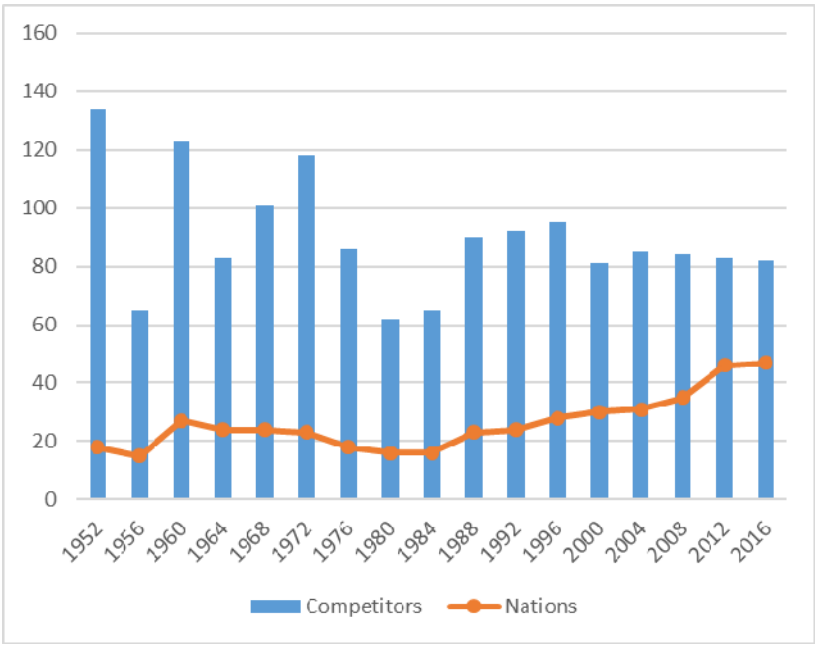

Figure 4. Number of gymnasts and nations at Olympic games on balance beam qualifications.

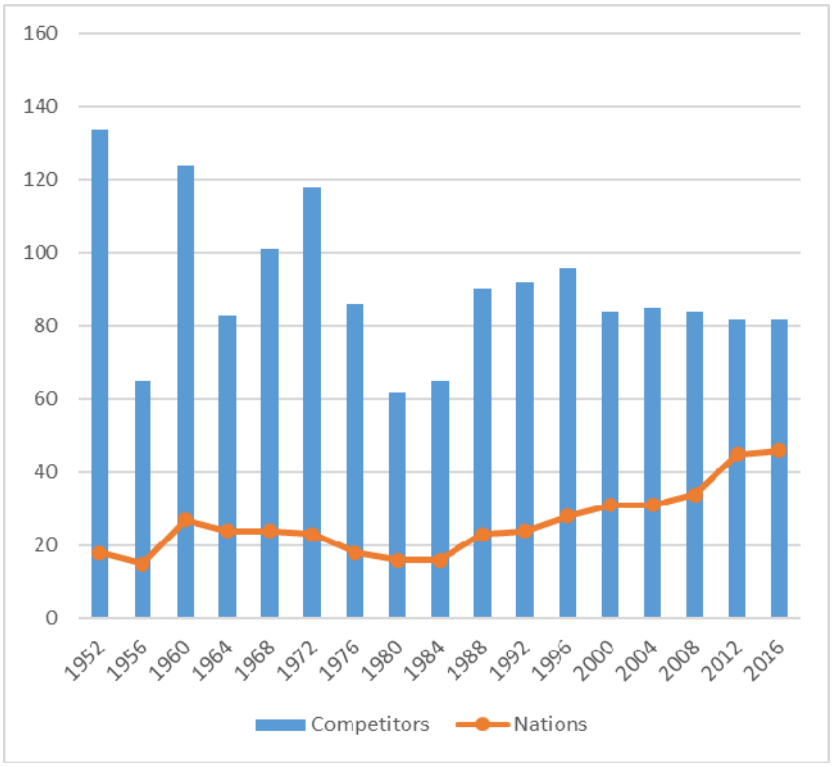

Figure 5. Number of gymnasts and nations at Olympic games on floor qualifications.

Table 1 shows the year and place of each OG, names of gymnasts who won medals in all-around competitions and individual apparatuses. Names of medalists are shown in the sequence related to the place they achieved: first name identifies the first place (gold medal), the second name identifies second place (silver medal) and the third name identifies third place (bronze medal).

Table 1
Names of gymnasts who won medal in all around and apparatus finals.

Year	*Place*	*All around*	*Vault*	*Uneven bars*	*Balance beam*	*Floor*
1952	Helsinki	Gorochovskia Maria Bocharova Nina Korondi Margit	Kalinchuk Yekaterina Gorochovskia Maria Minaicheva Galina	Korondi Margit Gorochovskia Maria Keleti Agnes	Bocharova Nina Gorochovskia Maria Korondi Margit	Keleti Agnes Gorochovskia Maria Korondi Margit
1956	Melbourne	Latynina Larysa Keleti Agnes Muratova Sofia	Latynina Larysa Manina Tamara Colling-Pettersson Ann S.	Keleti Agnes Latynina Larysa Muratova Sofia	Keleti Agnes Bosakova Eva Manina Tamara	Keleti Agnes Latynina Larysa Leustean Elena
1960	Rome	Latynina Larysa Muratova Sofia Astakhova Polina	Nikolayeva Marharyta Muratova Sofia Latynina Larysa	Astakhova Polina Latynina Larysa Lyukhina Tamara	Bosakova Eva Latynina Larysa Muratova Sofia	Latynina Larysa Astakhova Polina Lyukhina Tamara
1964	Tokio	Časlavska Vera Latynina Larysa Astakhova Polina	Časlavska Vera Latynina Larysa Radochia Birgit	Astakhova Polina Makray Katalin Latynina Larysa	Časlavska Vera Manina Tamara Latynina Larysa	Latynina Larysa Astakhova Polina Janosi-Ducza Aniko
1968	Mexico City	Časlavska Vera Voronina Zinaida Kuchinskaya Natalya	Časlavska Vera Zuchold Erika Voronina Zinaida	Časlavska Vera Janz Karin Voronina Zinaida	Kuchinskaya Natalya Časlavska Vera Petrik Larissa	Časlavska Vera Petrik Larissa Kuchinskaya Natalya
1972	Munich	Turischeva Lyudmila Janz Karin Lazakovich Tamara	Janz Karin Zuchold Erika Turischeva Lyudmila	Janz Karin Korbut Olga Zuchold Erika	Korbut Olga Lazakovich Tamara Janz Karin	Korbut Olga Turischeva Lyudmila Lazakovich Tamara
1976	Montreal	Comaneci Nadia Kim Nelli Turischeva Lyudmila	Kim Nelli Dombeck Carola Turischeva Lyudmila	Comaneci Nadia Ungureanu Teodora Egervari Marta	Comaneci Nadia Korbut Olga Ungureanu Teodora	Kim Nelli Turischeva Lyudmila Comaneci Nadia
1980	Moscow	Davydova Yelena Comaneci Nadia Gnauck Maxi	Shaposhnikova Natalya Kraaker Steffi Ruhn Melita	Gnauck Maxi Eberle Emilia Egervari Marta	Comaneci Nadia Davydova Yelena Shaposhnikova Yelena	Comaneci Nadia Kim Nelli Gnauck Maxi
1984	Los Angeles	Retton Mary Lou Szabo Ecaterina Pauca Simona	Szabo Ekaterina Retton Mary Lou Agache Lavinia	Yanhong Ma McNamara Julianne Retton Mary Lou	Pauca Simona Szabo Ecaterina Johnson Kathy	Szabo Ecaterina McNamara Julianne Retton Mary Lou
1988	Seoul	Shushunova Yelena Silivas Daniela Boginskaya Svetlana	Boginskaya Svetlana Potorac Gabriela Silivas Daniela	Silivas Daniela Kersten Dagmar Shushunova Yelena	Silivas Daniela Shushunova Yelena Mills Phoebe	Silivas Daniela Boginskaya Svetlana Dudeva Diana
1992	Barcelona	Gutsu Tatyana Miller Shannon Milosovici Lavinia	Milosovici Lavinia Onodi Henrietta Lysenko Tetiana	Li Liu Gutsu Tatyana Miller Shannon	Lysenko Tetiana Li Liu Miller Shannon	Milosovici Lavinia Onodi Henrietta Bontas Christina
1996	Atlanta	Podkopayeva Lilia Gogean Gina Amanar Simona	Amanar Simona Huilan Mo Gogean Gina	Khorkina Svetlana Wenjiing Bi Chow Amy	Miller Shannon Podkopayeva Lilia Gogean Gina	Podkopayeva Lilia Amanar Simona Dawes Dominique
2000	Sydney	Amanar Simona Olaru Maria Liu Xuan	Zamolodchikova Yelena Raducan Andreea Lobaznyuk Yekaterina	Khorkina Svetlana Ling Jie Yang Yun	Xuan Liu Lobaznyuk Yekaterina Produnova Yelena	Zamolodchikova Yelena Khorkina Svetlana Amanar Simona
2004	Athens	Patterson Carly Khorkina Svetlana Zhang Nan	Rosu Monica Hatch Annia Pavlova Anna	Lepennec Emilie Humphrey Terin Kupets Courtney	Ponor Catalina Patterson Carly Eremia Alexandra G.	Ponor Catalina Sofronie Nicoleta Daniela Moreno Patricia
2008	Beijing	Liukin Nastia Johnson Shawn Yang Yilin	Hong Un Jong Chusovitina Oksana Cheng Fei	He Kexin Liukin Nastia Yang Yilin	Johnson Shawn Liukin Nastia Cheng Fei	Izbasa Sandra Raluca Johnson Shawn Liukin Nastia
2012	London	Douglas Gabrielle Komova Victoria Mustafina Aliya	Izbasa Sandra Raluca Maroney Mc Kayla Paseka Maria	Mustafina Aliya He Kexin Tweeddle Elizabeth	Deng Linlin Sui Lu Raisman Alexandra	Raisman Alexandra Ponor Catalina Mustafina Aliya
2016	Rio de Janeiro	Biles Simone Raisman Alexandra Mustafina Aliya	Biles Simone Paseka Maria Steingruber Gulia	Mustafina Aliya Kocian Madison Scheder Sofie	Wevers Sanne Hernandez Lauren Biles Simone	Biles Simone Raisman Alexandra Tinkler Amy

Figures 6 to 10 show sum of all medals won by all around medalists, sum of gold medals won by all around medalists, sum of silver medals won by all around medalists, sum of bronze medals won by all around medalists.

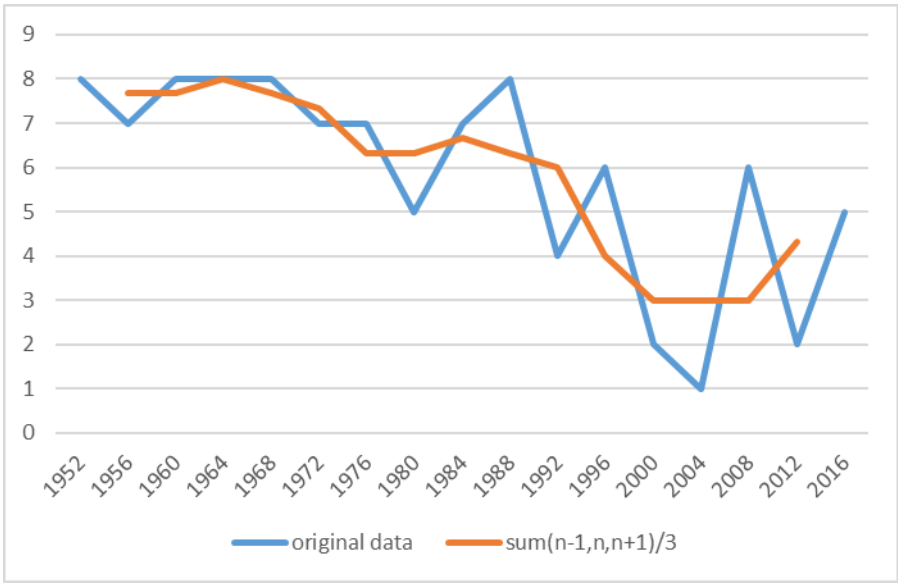

Figure 6. Sum of all medals won by all around medalists. Legend: Blue line denotes the absolute sum of all medals. Orange line denotes trends (sum of all medals at previous (n-1), recent (n) and next (n+1) OG divided by 3.

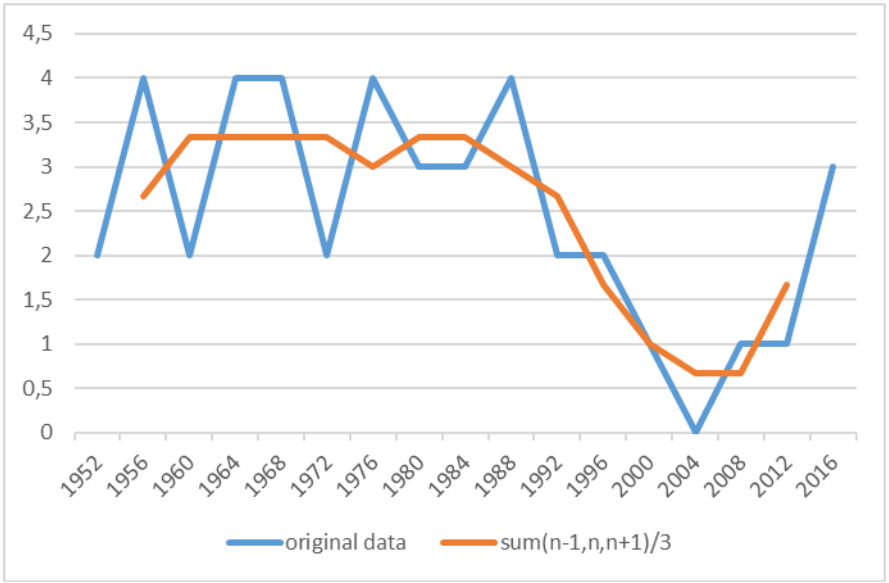

Figure 7. Sum of gold medals won by all around medalists. Legend: Blue line denotes the absolute sum of all medals. Orange line denotes trends (sum of all medals at previous (n-1), recent (n) and next (n+1) OG divided by 3.

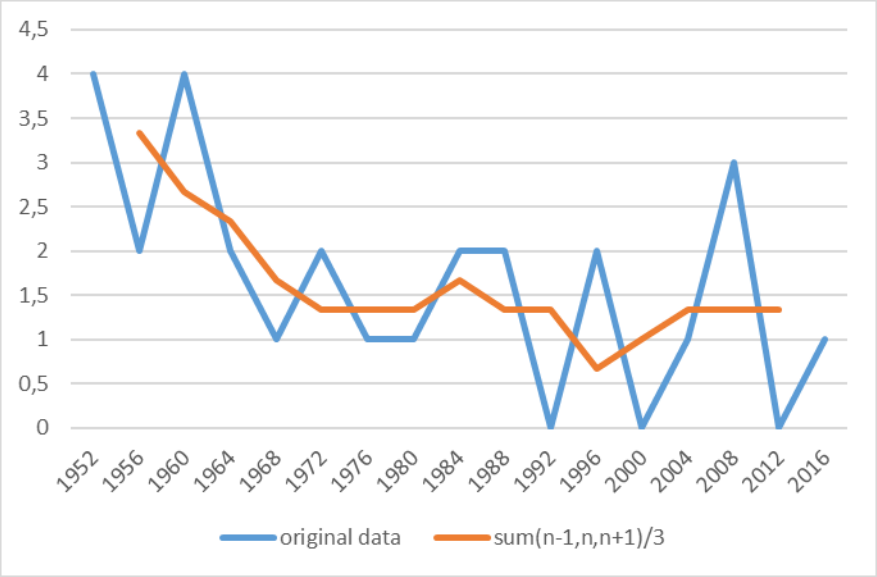

Figure 8. Sum of silver medals won by all around medalists. Legend: Blue line denotes the absolute sum of all medals. Orange line denotes trends (sum of all medals at previous (n-1), recent (n) and next (n+1) OG divided by 3.

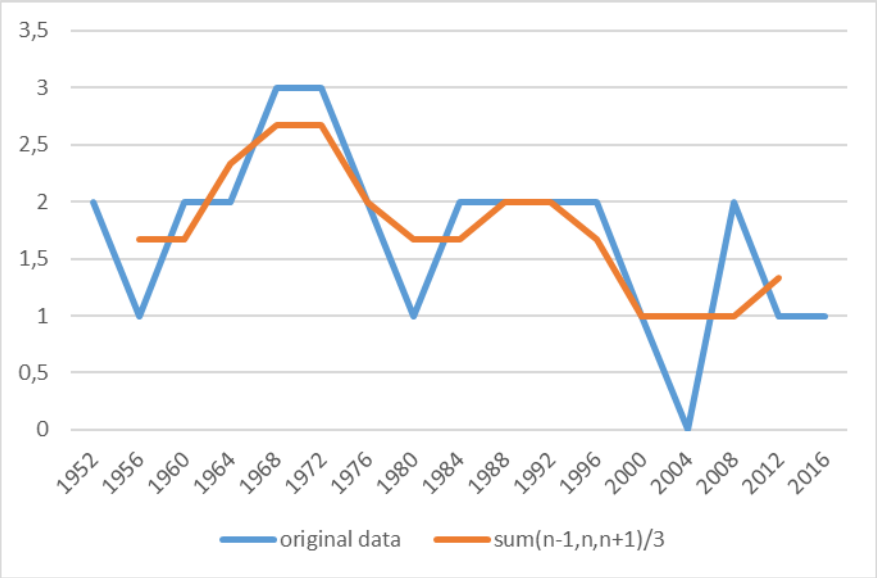

Figure 9. Sum of bronze medals won by all around medalists. Legend: Blue line denotes the absolute sum of all medals. Orange line denotes trends (sum of all medals at previous (n-1), recent (n) and next (n+1) OG divided by 3.

Olympic all-around champion efficiency was calculated (Figure 10) from sum of all medals won by all-around champions on apparatuses divided by 4 (maximum 4 apparatus medals can be earned by each all-around champion).

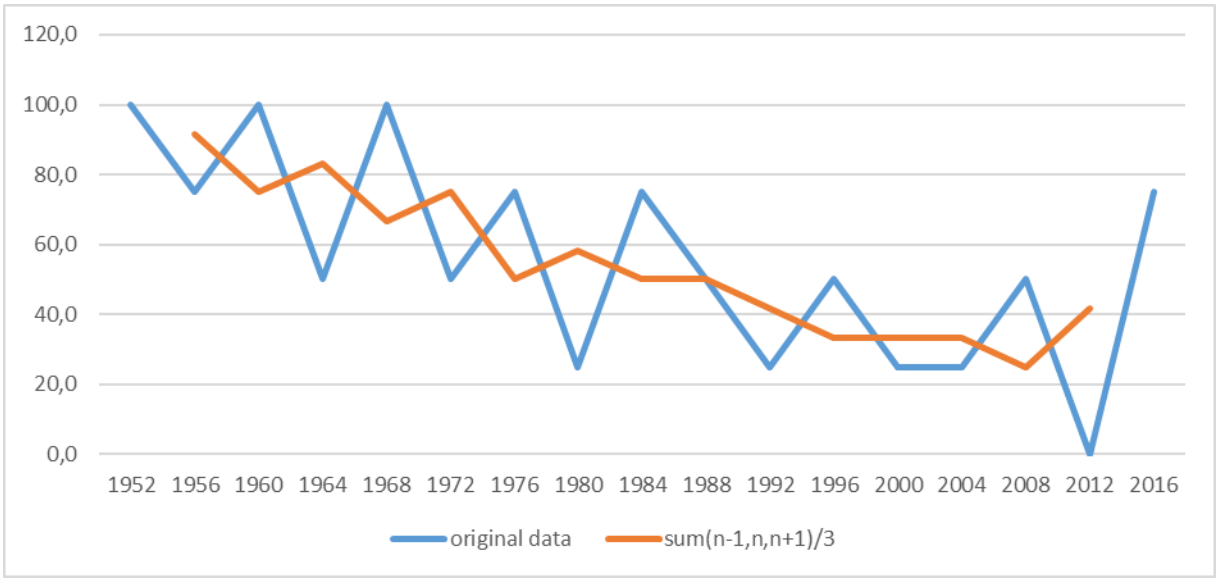

Figure 10. Olympic Champion efficiency trend of all around champions.

DISCUSSION

Number of gymnasts and number of nations participating at OG varies during observed period of time (Figure 1 - 5). Greater declines are detected for Melbourne, 1956, for Moscow, 1980, and Los Angeles, 1984. At summer games there had been 5 boycotts (Wikipedia, 2018) in the observed period and all three games 1956, 1980 and 1984 are included. In 1956 boycotting countries were: Egipt, Iraq, Lebanon, Netherlands, Cambodia, Spain, Switzerland and Peoples Republic of China. In 1980 boycotting countries were: Albania, Antigua and Barbuda, Argentina, Bahamas, Bahrain, Bangladesh, Barbados, Belize, Bermuda, Bolivia, Canada, Cayman Islands, Central African Republic, Chad, Chile, China, Egypt, El Salvador, Fiji, Gabon, Gambia, Ghana, Haiti, Honduras, Hong Kong, Indonesia, Iran, Israel, Ivory Coast, Japan, Kenya, South Korea, Liberia, Liechtenstein, Malawi, Malaysia, Mauritania, Monaco, Mauritius, Morocco, Netherlands Antilles, Niger, Norway, Pakistan, Panama, Papua New Guinea, Paraguay, Philippines, Qatar, Saudi Arabia, Singapore, Somalia, Sudan, Suriname, Swaziland, Chinese Taipei, Thailand, Togo, Tunisia, Turkey, United Arab Emirates, United States, Uruguay, United States Virgin Islands, West Germany, Zaire. In 1984 boycotting countries were: Soviet Union, Bulgaria, East Germany, Mongolia, Vietnam, Laos, Czechoslovakia, Afghanistan, Hungary, Poland, Cuba, South Yemen, North Korea, Ethiopia, Angola, Albania, Iran, Lybia (Wikipedia, 2018). This explains the lower number of participants at those games. Among listed countries we can find very powerful gymnastic countries and one can speculate that results could be different if all eligible participants would compete. After Rome, 1960, number of nations continually declined until OG 1984 (Los Angeles, USA), mostly due to political reasons. After OG 1984 (Los Angeles, USA) numbers of participants varied but number of nations competing at qualifications is in constant incline (except at OG 1996, Atlanta, USA). After OG 1988 (Seul, South Korea) many countries divided into smaller states (i.e. Soviet union, Yugoslavia, Czechoslovakia), but surprisingly the number of participants and nations at women's artistic gymnastic stayed almost the same. After OG 1992 the number of nations was constantly rising. In Atlanta, 1996, compulsory exercises had to be performed for the last time at OG and in 2000 the number of nations raised. Also at Athens, 2004, the maximum score was set at

10.00 points for the last time. After that the COP changed substantially and that was the beginning of open ended scores. After this there was a constant raise of nation number at OG.

The situation on vault is very interesting: we can observe how the changes in COP influenced the number of competitors on vault, and also how numerous nations managed to find an opportunity for a good result on this apparatus. At Beijing 2008, the number of participants on vault dropped significantly, mostly due to changes in COP where only one vault is necessary at all-around competition. If competitor wanted to compete in vault finals she needed to perform two different vaults. With open ended COP not many competitors had 2 different vaults with high enough difficulty. It is interesting to see that the number of nations competing at vault is relatively high: 13 nations and 15 competitors at Beijing 2008, 15 nations and 18 competitors at London, 2012, and 16 nations and 19 competitors at Rio de Janiero, 2016.

Table 1 shows names of all medalist from observed period at all around competitions and apparatus finals. Only 2 competitors won all-around tittle twice: Larysa Latynina (Russia, ex – Soviet Union) won all-around title at OG 1956 (Melbourne, Australia) and OG 1960 (Rome, Italy) and Vera Časlavska (Czech, ex – Czechoslovakia) won OG 1964 (Tokio, Japan) and OG 1968 (Mexico City, Mexico).

It should be noted that all-around finals started to be organized as a separate competition in Munich, 1972 (Wallechinsky, & Loucky, 2012). Before that there was no extra competition for all around finals, they just announced all-around medalists based on a common competition that contained four apparatuses and also served as a qualification for single apparatus finals. Apparatus finals was organized for the first time at Melbourne, 1956.

Figure 6 shows a good success of all-around medalists at apparatus finals. At the beginning of observed period the number of apparatus medals were very high (up to 8 from 12 possible medals), but with the advent of a more demanding and complexed element structure the ability of achieving podium by all-around medalists is slowly dropping. Figures 6 to 9 show sum of gold, silver and bronze medals won by all-around medalists. Trends are similar as described above. Figure 10 shows efficiency of all around champions on apparatus finals. From the whole history of women artistic gymnastics winner in all-around competition is considered as the queen of gymnastics. At Helsinki, 1952, Rome, 1960, and Mexico City, 1968 competitions, the efficiency was of all-round champions was 100%. In these cases all-around champion also got gold, silver or bronze medal at each out of the four apparatus finals. We can also see that there were 4 Olympic champions with 75% efficiency – meaning that they took 3 medals at apparatus finals. The exact names of the all-around champions and their success at individual apparatus competitions are shown in the table 1. The only case in the whole OG history regarding women's artistic gymnastics when efficiency of all-round champion was 0% was at London, 2012 where the Olympic champion didn't take any medals at apparatus finals. We can conclude that all-around gymnasts play an important role at apparatus finals however the predomination of distinctive specialists on apparatuses is slowly emerging in the last period and the efficiency of all-around champions at individual apparatuses is dropping. There are however certain exceptions, for example see the strong predominance of Simone Biles at Rio de Janiero, 2016, who shifted all statistics upwards. There is also a strong influence of rules of OG qualification since they favor the qualification of all-round competent gymnasts; dedicated apparatus specialists have a more difficult task to qualify for OG. With only 4 apparatuses from which three of them are directly related to acrobatics (vault, balance beam, floor) most gymnasts are still expected to compete on all four apparatuses. Therefore we can expect to see

continuing success of all-around medalists at apparatus finals. However the obvious trend shows that the supreme efficiency of all-around champions to reach the podium at majority apparatus finals cannot be expected any more.

Drawbacks of our study include the limitation of each all around champion's efficiency to a single OG event (some competitors have competed at more than one event and a possible extension of analysis to their performance at all relevant OG events was not done). On the other hand, a full coverage of modern gymnastic era with four apparatuses is covered by our analysis and this is a strength of our study.

CONCLUSIONS

Our results show that with the advent of a more demanding and complexed element structure the ability of achieving podium by all-around medalists is dropping. A very high efficiency of all-around champions to reach the podium at every apparatus final has dropped and this trend parallels the trend of diminishing sum of individual apparatus medals that have been earned by all-around medalists. This may be a sign of increased success of more specialized competitors. With only four disciplines within all-around competition, and with three of them directly related to acrobatics, we can expect to see continuing success of all-around medalists at apparatus finals. However, a clear trend shows that the supreme efficiency of all-around champions to reach the podium at majority apparatus finals cannot be expected any more.

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HOW SUCCESSFUL ARE MEN ALL-AROUND OLYMPIC MEDALISTS ON APPARATUS EVENTS AT OLYMPIC GAMES FROM 1924 TO 2016

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Original article

Abstract

At Olympic Games (OG) 1896 in Athens all-around competition in gymnastics was not a discipline. First time all-around title in gymnastics at OG was awarded in Paris in the year of 1900, however there were no apparatus awards given until OG 1924 in Paris. The article shows a historical research and follows development of OG all-around medallists and their success with relation to winning medals on individual apparatus. In Paris1924 Leon Štukelj (Slovenia, ex-Yugoslavia) won all-around and horizontal bar gold medal. Since then all-around medallists shared very different success in apparatus ranking. The last multiple winner was Vitaly Scherbo (Belarus, ex-Soviet Union) who at OG 1992 won all-around and three apparatus finals (rings, vault and parallel bars). Since then such achievement has not been repeated yet. With open-ended difficulty value in the Code of Points and special competitions held by FIG for apparatus specialist, the doors are opening to more apparatus specialists to attend OG and chances to repeat Scherbo's success are getting smaller

Key words: *history, men artistic gymnastics, Olympic Games, medallists.*

INTRODUCTION

Gymnastics for men was on the schedule of the first modern Olympic Games in 1896, and it has been on the Olympic agenda continually since 1924 (Strauss, 2017). Development of disciplines in artistic gymnastics at Olympic Games (OG) went through burning beginning and since 1932 it became constant as number of disciplines, but a format of how winners were determined has been changing until nowadays. At the first OG of modern age in 1896 in Athens (Greece), medals were given only for apparatus results on pommel horse, still rings, vault, parallel bars and high bar. At OG 1900 in Paris (France), only medals for all-around results were awarded. At next OG in St. Louis (USA) in 1904 competitions were organized separately and months apart for all-around and for apparatus (without floor exercise). At OG 1906 in Athens celebrating 10 years of the first OG only all-around results were awarded. Next OG from 1908 London (UK) up to OG 1920 Antwerp (Netherland) again

only all-around medals were awarded (Wallechinsky, 2004). Next two OG in Paris (1924) and Amsterdam (1928, Netherland) besides all-around medals, also apparatus medals were awarded for all disciplines except for floor exercise (Štukelj, 1989). Leon Štukelj (Slovenia, ex Yougoslavia) was the first Olympic champion in all-around who also won the apparatus gold medal for horizontal bar. Since OG in 1932 (Los Angeles, USA) onward for all-around and six apparatus disciplines – floor exercise, pommel horse, rings, vault, parallel bars, horizontal bar – medals were awarded. Later up to OG in Melbourne (Australia) 1956 team competition served also to determine all-around and apparatus medallists. At OG in Rome (Italy) 1960 apparatus finals competition began, with all-around finals gymnasts started at OG 1972 in Munich (Germany). Since then the format of disciplines is the same, with changes of number of gymnasts in all-around finals (drop from 36 to 24) and apparatus finals (rise from 6 to 8) (Wallechinsky, 2004). For the last OG 2016 in Rio (Brazil) International gymnastics federation's (FIG) selection process of gymnasts who can compete at OG was as follows (FIG, 2015): 12 teams of 5 gymnasts, World championship apparatus medallists (7 gymnasts fulfilled this criteria; 2 of them would qualify also via all-around) who are not part of any competing team, host nation representative (who was already a member from host team qualified), tripartite invitation (invited gymnast from Monaco, who competed in all-around), a gymnast from Africa (all-around gymnast), and 29 gymnasts qualified via all-around results either in 2015 at World Championship either at 2016 Olympic test event. At Rio OG 98 gymnasts competed, half of them (49) competed in all-around, in teams; one to three gymnasts competed in all-around (BBC Sport, 2017). It is worth to notice that all-around gymnasts competing at OG tend to be older at OG comparing to previous ones (Atiković, Delaš Kalinski & Čuk, 2017).

Code of Points (COP) determined the rules of how to evaluate routines. Between 1924 and 1996, gymnasts had to perform two routines - compulsory and optional - on each apparatus. Despite the fact that in the past many changes were made in the COP, but until 2006 the highest value of gymnast's score limited towards fixed number (mostly towards 10.0 points). After 2006, the difficulty values of the score are evaluated upon open end of the score (each gymnasts have his theoretical maximum score determined with content of his exercise) (FIG, 2013, Kunčič & Mešl, 2017). The rise of precision of judging and its regulation was paralleled by the fact that values of difficulty elements increased (Čuk, & Atiković, 2009; Čuk, & Forbes,2010; Bučar Pajek, Čuk, Pajek, Karácsony & Leskošek, 2012; Bučar Pajek, Čuk, Pajek, Kovač, & Leskošek, 2013; Delaš Kalinski, Atiković, Jelaska, & Milić, 2016). It is important to notice that apparatus events are designed according to gymnast's main position obtained on apparatus. In such we distinguish apparatus with dominant support on their feet (floor exercise, vault), dominant support on arms (pommel horse, parallel bars) and dominant hang (rings, horizontal bar). According to Arkaev & Suchilin (2003), gymnastics cannot be performed without the ability to jump with high level of development of the muscles of upper back, lower back and the trunk. There were many changes also in apparatus design - changes of apparatus materials or physical characteristics of apparatus at the competitions - all gymnasts competed at particular OG on the apparatus with same characteristics. Up to now, it was found that with open difficulty value in the COP the highest predictive value at 2009 European Championship for all-around results were results for difficulty value on parallel bars (Čuk, Forbes, 2010).

The aim of our historical research is to follow the development of OG all-around medallists and their success with relation to winning medals on individual apparatus, addressing their possible causes and future impacts.

METHODS

All data from Wallechinsky (2004) were collected. The time span we analysed is from OG 1924 up to OG 2016, as from 1924 all-around and apparatus medals were awarded. Following variables per each OG were analysed: number of participants, number of participant's nation, name of gymnasts who won medals in all-around and apparatus, sum of all medals won by all-around medallists, sum of gold medals won by all-around medallists, sum of silver medals won by all-around medallists, sum of bronze medals won by all-around medallists, sum of all medals won by Olympic champion, percentage of all medals won by all-around medallists (excluding team medals) on apparatus (for individuals altogether it is possible to gain 18 medals), percentage of all medals won by Olympic Champion (out of 18 possible apparatus medals), as a gymnast can earn maximum 6 apparatus medals, it was calculated also Olympic Champion efficiency (all apparatus medals divided by 6). From results, we determined on which all-around champions took most apparatus medals.

RESULTS

Results are shown in Figures 1 to 7, Tables 1 and 2.

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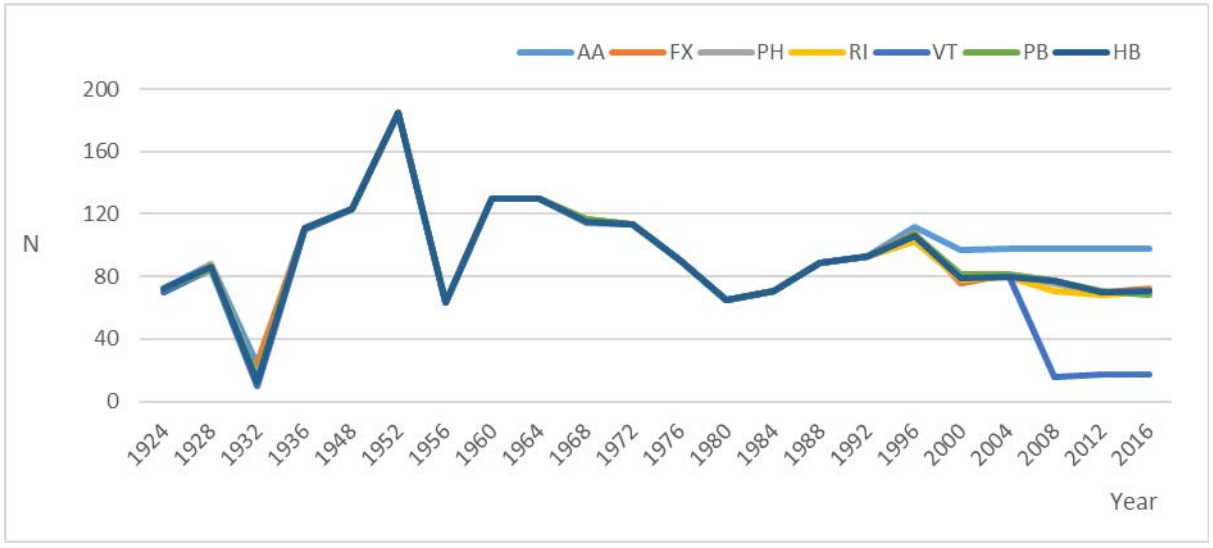

Figure 1. Number of gymnasts competing at OG between 1924 and 2016.

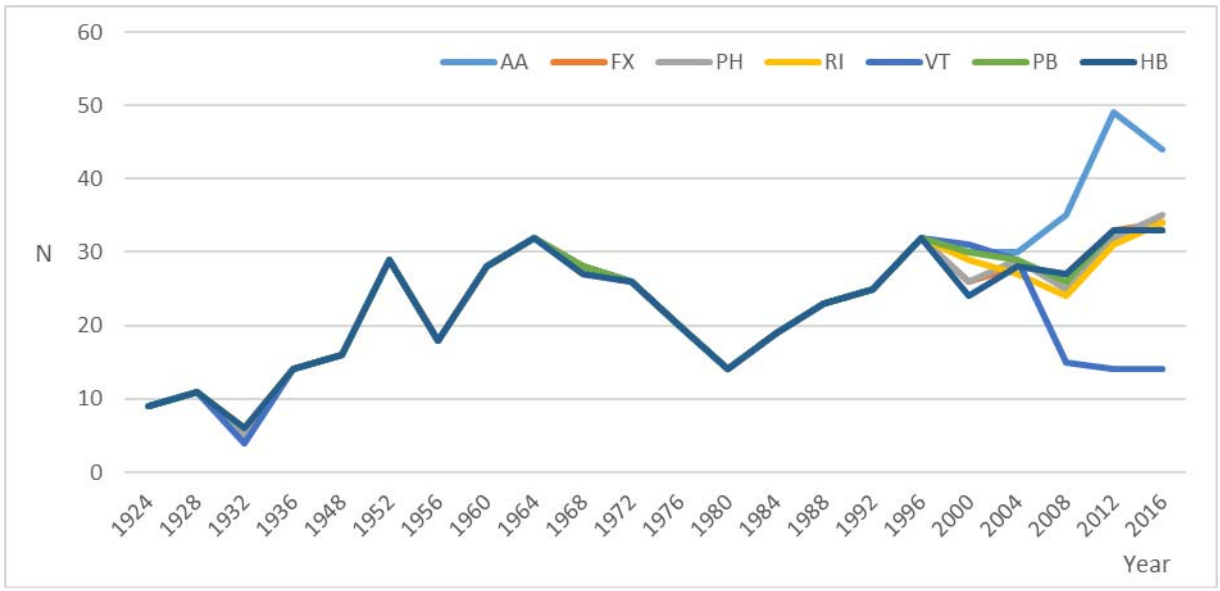

Figure 2. Number of participating nations at OG between 1924 and 2016.

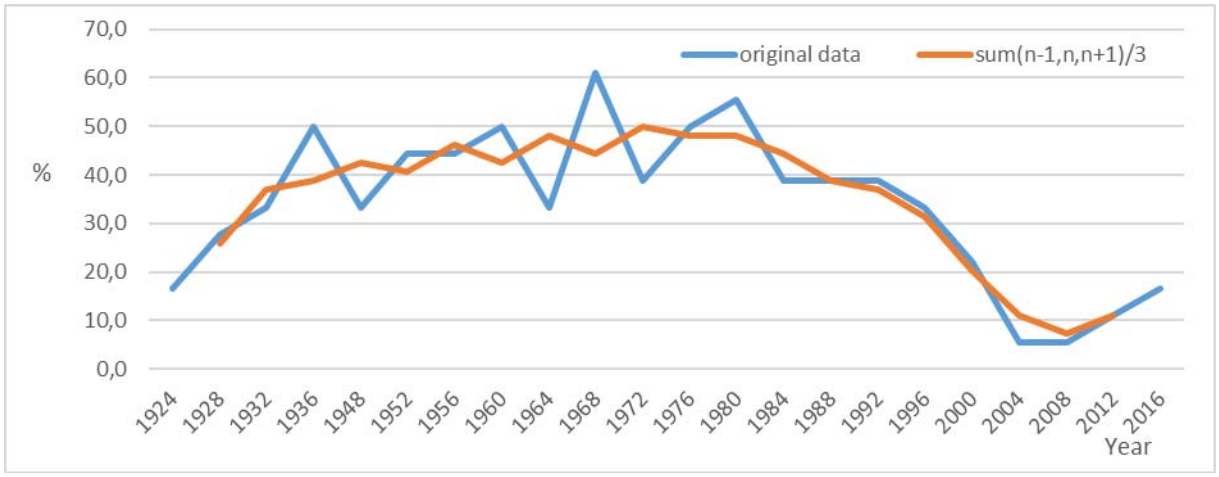

Figure 3. Percentage of individual medals won by AA medallists between 1924 and 2016
Legend: Blue line denotes the absolute sum of medals. Orange line denotes trends (sum of medals at previous (n-1), recent (n) and next (n+1) OG divided by 3.

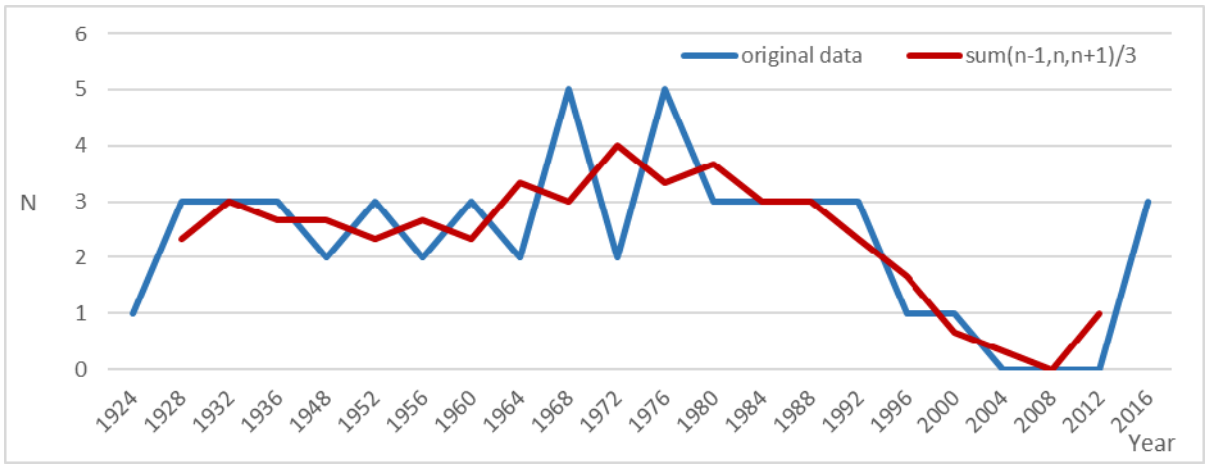

Figure 4. All-around medallists with gold apparatus medals between 1924 and 2016; Legend: Blue line denotes the absolute sum of medals. Red line denotes trends (sum of medals at previous (n-1), recent (n) and next (n+1) OG divided by 3.

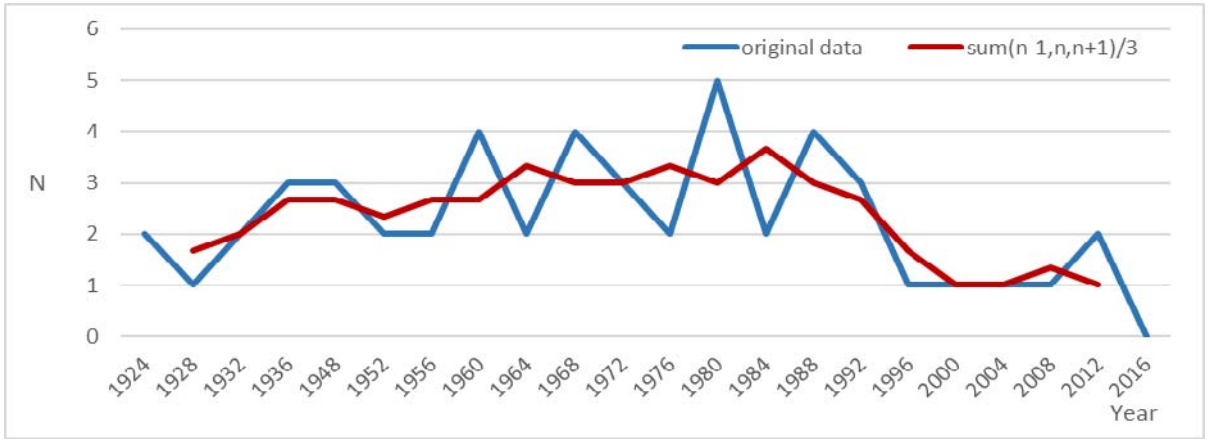

Figure 5. All-around medallists with silver apparatus medals between 1924 and 2016; Legend: Blue line denotes the absolute sum of medals. Red line denotes trends (sum of medals at previous (n-1), recent (n) and next (n+1) OG divided by 3.

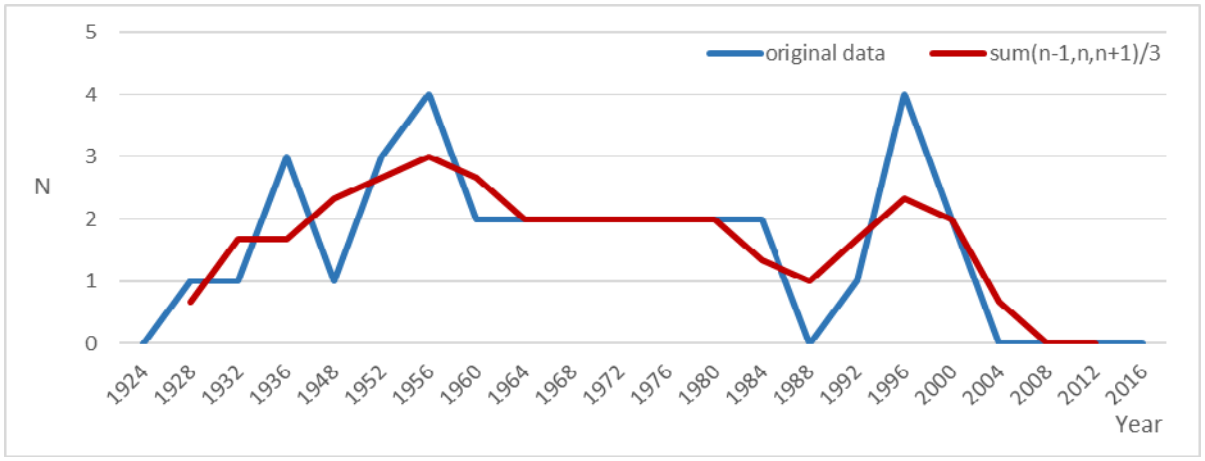

Figure 6. All-around medallists with bronze apparatus medals between 1924 and 2016; Legend: Blue line denotes the absolute sum of medals. Red line denotes trends (sum of medals at previous (n-1), recent (n) and next (n+1) OG divided by 3.

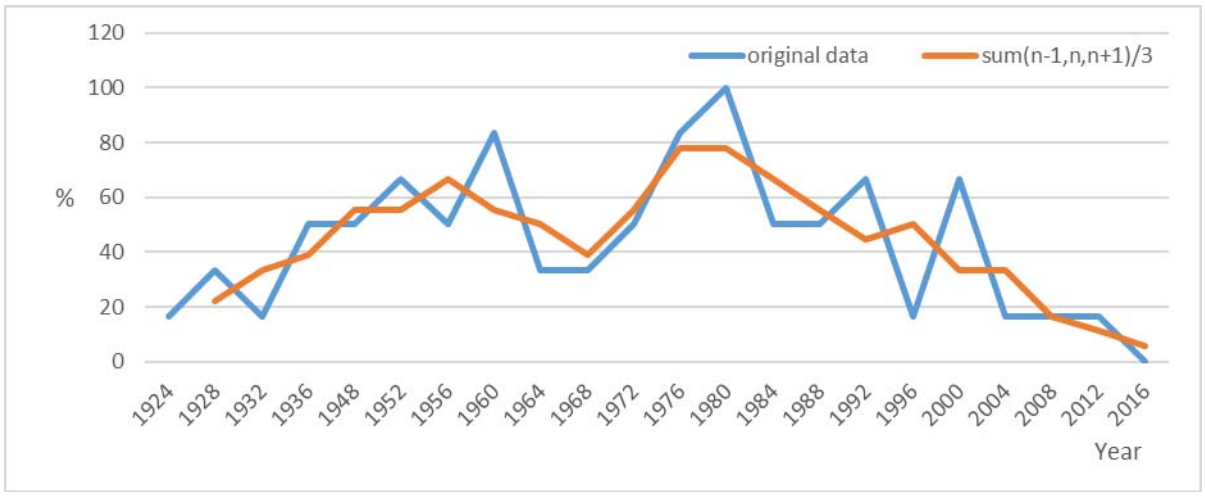

Figure 7. Efficiency of Olympic champions on winning apparatus medals between 1924 and 2016; Legend: Blue line denotes the absolute sum of medals. Orange line denotes trends (sum of medals at previous (n-1), recent (n) and next (n+1) OG divided by 3.

Table 1 shows the year and place of each OG, names of gymnasts who won medals in all-around competitions and individual apparatuses. Names of medalists are shown in the sequence related to the place they achieved: fist name identifies first place (gold medal), second name identifies second place (silver medal) and third name identifies third place (bronze medal).

Table 1
Names of gymnasts winning medals in all-around and apparatus finals.

Year	***Place***	***All-around***	***Floor***	***Pommel horse***	***Rings***	***Vault***	***Parallel bars***	***Horizontal bar***
		Štukelj Leon		Wilhelm Josef	Martino Francesco	Kriz Frank	Guttinger August	Štukelj Leon
		Pražak Robert		Gutwenigen Jean	Pražak Robert	Koutny Jan	Pražak Robert	Gutweniger Jean
1924	Paris	Supčih Bedrich		Rebetez Antoine	Vacha Ladislav	Morkovsky Bohumil	Zampori Giorgio	Higelin Andre
		Miez Georges		Hanggi Hermann	Štukelj Leon	Mack Eugen	Vacha Ladislav	Miez Georges
		Hangi Hermann		Miez Georges	Vacha Ladislav	Loffler Emanuel	Primožič Josip	Neri Romeo
1928	Amsterdam	Štukelj Leon		Savolainen Heikki	Loffler Emanuel	Derganc Stane	Hanggi Hermann	Mack Eugen
		Neri Romeu	Pelle Istvan	Pelle Istvan	Gulack George	Guglielmetti Savino	Neri Romeo	Bixler Dallas
	Los	Pelle Istvan	Miez Georges	Bonoli Omero	Denton William	Jochim Alfred	Pelle Istvan	Savolainen Heikki
1932	Angeles	Savolainen Heikki	Lertora Mario	Haubold Frank	Lattuada Giovanni	Carmichael Edward	Savolainen Heikki	Terasvirta Einari
		Schwarzmann Alfred	Miez Georges	Frey Konrad	Hudec Alois	Schwarzmann Alfred	Frey Konrad	Saarvala Aleksanteri
		Mack Eugen	Josef Walter	Mack Eugen	Štukelj Leon	Mack Eugen	Reusch Michael	Frey Konrad
1936	Berlin	Frey Konrad	Frey Konrad	Bachmann Albert	Volz Matthias	Volz Matthias	Schwarzmann Alfred	Schwarzmann Alfred
		Huhtanen Veikko	Pataki Fenenc	Aaltonen Paavo	Frei Karl	Aaltonen Paavo	Reusch Michael	Stalder Josef Lehmann
		Lehmann Walter	Mogyorosi-Klencs	Huhtanen Veikko	Reusch Michael	Rove Olavi	Huhtanen Veikko	Huhtanen Veikko
		Aaltonen Paavo	Janos	Savolainen Heikki	Ružička Zdenek	Mogyorosi-Klencs	Kipfer Christian	Gunthard Jack
1948	London		Ružička Zdenek			Janos		
		Chukarin Viktor	Thoresson K William	Chukarin Viktor	Shaginyan Grant	Chukarin Viktor	Eugster Hans	Gunthard Jack
		Shaginyan Grant	Jokiel Jerzy	Korolkov Yevgeny	Chukarin Viktor	Takemoto Masao	Chukarin Viktor	Schwarzmann Alfred
1952	Helsinki	Stalder Josef	Uesako Tadao	Shaginyan Grant	Eugster Hans	Ono Takashi	Stalder Josef	Stalder Josef
		Chukarin Viktor	Muratov Valentin	Shaklin Borys	Azaryan Albert	Bantz Helmut	Chukarin Viktor	Ono Takashi
		Ono Takashi	Aihara Nobuyoki	Ono Takashi	Muratov Valentin	Muratov Valentin	Kubota Masami	Tytov Yuti
1956	Melbourne	Tytov Yuri	Chukarin Viktor	Chukarin Viktor	Kubota Masami	Tytov Yuti	Ono Takashi	Takemoto Masao
		Shakhlin Borys	Aihara Nobuyoki	Ekman Eugen	Azaryan Albert	Ono Takashi	Shakhlin Borys	Ono Takashi
		Ono Takashi	Tytov Yuri	Shaklin Borys	Shakhlin Borys	Shakhlin Borys	Carminucci Giovanni	Takemoto Masao
1960	Rome	Tytov Yuri	Menichelli Franco	Tsurumi Shuji	Kapsazov Velik	Portnoy Vladimir	Ono Takashi	Shakhlin Borys
		Endo Yukio	Menichelli Franco	Cerar Miroslav	Haytta Takuji	Yamashita Haruhiro	Endo Yukio	Shakhlin Borys
		Lisitsky Vikton	Endo Yukio	Tsurumi Shuji	Menichelli Franco	Lisitsky Viktor	Tsurumi Shuji	Tytov Yuti
1964	Tokio	Shakhlin Borys	Lisitsky Viktor	Tsapenko Yuri	Shakhlin Borys	Rantakari Hannu	Menichelli Franco	Cerar Miroslav
		Kato Sawao	Kato Sawao	Cerar Miroslav	Nakayama Akinori	Voronin Mikhail	Nakayama Akinori	Nakayama Akinori
	Mexico	Voronin Mikhail	Nakayama Akinori	Eino Laiho Olli	Voronin Mikhail	Endo Yukio	Voronin Mikhail	Voronin Mikhail
1968	City	Nakayama Akinori	Kato Takeshi	Voronin Mikhail	Kato Sawao	Diomidov Sergei	Klimenko Vladimir	Kenmotsu Eizo
		Kato Sawao	Andrianov Nikolai	Klimenko Viktor	Nakayama Akinori	Koaste Klaus	Kato Sawao	Tsukahara Mitsuo
		Kenmotsu Eizo	Nakayama Akinori	Kato Sawao	Voronin Mikhail	Klimenko Viktor	Kasamatsu Shigeru	Kato Sawao
1972	Munich	Nakayama Akinori	Kasamatsu Shigeru	Kenmotsu Eizo	Tsukahara Mitsuo	Andrianov Nikolai	Kenmotsu Eizo	Kasamatsu Shigeru

Year	*Place*	*All-around*	*Floor*	*Pommel horse*	*Rings*	*Vault*	*Parallel bars*	*Horizontal bar*
1976	Montreal	Andrianov Nikolai Kato Sawao Tsukahara Mitsuo	Andrianov Nikolai Marchenko Vladimir Kormann Peter	Magyar Zoltan Kenmotsu Eizo Andrianov Nikolai	Andrianov Nikolai Dityatin Alexandr Grecu Danut	Andrianov Nikolai Tsukahara Mitsuo Kajiyama Hiroshi	Kato Sawao Andrianov Nikolai Tsukahara Mitsuo	Tsukahara Mitsuo Kenmotsu Eizo Boerio Henry
1980	Moscow	Dityatin Aleksandr Andrianov Nikolai Deltchev Stoyan	Bruecker Roland Andrianov Nikolai Dityatin Aleksandr	Magyar Zoltan Dityatin Alexandr Nikolay Michael	Dityatin Alexandr Tkachyov Aleksandr Tabak Jiri	Andrianov Nikolai Dityatin Alexandr Bruecknen Roland	Tkachyov Aleksandr Dityatin Alexandr Bruecknen Roland	Deltchev Stoyan Dityatin Alexandr Andrianov Nikolai
1984	Los Angeles	Gushiken Koji Vidmar Peter Ning Li	Ning Li Yun Lou Sotomura Koji	Ning Li Vidmar Peter Dagget Timothy	Gushiken Koji Ning Li Gaylord Mitchell	Yun Lou Gaylord Mitchell Gushiken Koji	Conner Bart Kajitani Nobuyiku Gaylord Mitchell	Morisue Shinji Fei Tong Gushiken Koji
1988	Seoul	Artemov Vladimir Lyukin Valery Bilozerchev Dmitri	Kharkov Sergei Artemov Vladimir Iketani Yukio	Bilozerchev Dmitri Borkai Zsolt Geraskov Lubomir	Behrendt Holger Bilozerchev Dmitri Tippelt Sven	Yun Lou Kroll Sylvio Jong-hoon Park	Artemov Vladimir Lyukin Valery Tippelt Sven	Artemov Vladimir Lyukin Valery Behrendt Holgen
1992	Barcelona	Scherbo Vitaly Misyutin Hryhoriy Belenki Valeri	Xiaoshuang Li Iketani Yukio Misyutin Hryhoriy	Gil-su Pae Scherbo Vitaly Wecker Andreas	Scherbo Vitaly Jing Li Xiaoshuang Li	Scherbo Vitaly Misyutin Hryhoriy Ok-ryul Yoo	Scherbo Vitaly Jing Li Linyao Guo	Dimas Trent Misyutin Hryhoriy Wecker Andreas
1996	Atlanta	Xiaoshuang Li Nemov Aleksei Scherbo Vitaly	Melissanidis Ioannis Xiaoshuang Li Nemov Aleksei	Li Donghua Urzica Marius Nemov Aleksei	Chechi Jury Burinca Dan Csollaany Szilveszter	Nemov Aleksei Hong-chul Yeo Scherbo Vitaly	Sharipov Rustam Lynch Jair Scherbo Vitaly	Wecker Andreas Dunev Krasimir Bin Fan
2000	Sydney	Nemov Aleksei Yang Wei Beresh Oleksandr	Vihrovs Igors Nemov Aleksei Yovchev Yordan	Urzica Marius Poujade Eric Nemov Aleksei	Csollaany Szilveszter Tampakos Dimosthenis Yovchev Yordan	Deferr Angel Gervasio Bondarenko Aleksei Blanik Leszek	Xiaopeng Li Joo-hyung Lee Nemov Aleksei	Nemov Aleksei Varonian Benjamin Joo-hyung Lee
2004	Athens	Hamm Paul Kim Dae Eun Yang Tae Young	Shewfelt Kyle Dragulescu Marian Jovtchev Jordan	Teng Haibin Urzica Marius Daniel Kashima Takehiro	Tampakos Dimosthenis Jovtchev Jordan Chechi Yuri	Deferr Gervasio Sapronenko Evgeni Dragulescu Marian	Goncharov Valeri Tomita Hiroyuki Xiaopeng Li	Cassina Igor Hamm Paul Yoneda Isao
2008	Beijing	Yang Wei Uchimura Kohei Caranobe Benoit	Zou Kai Deferr Gervasio Golotsutskov Anton	Xiao Qin Ude Filip Smith Louis	Chen Yibing Yang Wie Vorobiov Oleksandr	Blanik Leszek Bouhail Thomas Golotsutskov Anton	Xiaopeng Li Yoo Wonchul Fokin Anton	Zou Kai Horton Jonathan Hambuechen Fabian
2012	London	Uchimura Kohei Nguyen Marcel Leyva Danell	Zou Kai Uchimura Kohei Ablyazin Denis	Berki Krisztian Smith Louis Whitlock Max	Zanetti Arthur Chen Yibing Morandi Matteo	Yang Hak Seon Ablyazin Denis Radivilov Igor	Feng Zhe Nguyen Marcel Sabot Hamilton	Zonderland Epke Hambuchen Fabian Zou Kai
2016	Rio de Janeiro	Uchimura Kohei Verniaiev Oleg Whitlock Max	Whitlock Max Hypolito Diego Mariano Arthur	Whitlock Max Smith Louis Naddour Alexander	Petrounias Eleftherios Zanetti Arthur Ablyazin Denis	Ri Se Gwang Ablyazin Denis Shirai Kenzo	Verniaiev Oleg Leyva Danell Belyavskiy David	Hambuchen Fabian Leyva Danell Wilson Nile

Table 2
Sum of medals per apparatus for all-around medallists, all-around champions and basic gymnast's position on apparatus.

	Gold	Silver	Bronze	Sum
All-around medallists				
Floor	5	9	6	20
Pommel horse	8	9	7	24
Rings	7	7	2	16
Vault	9	5	3	17
Parallel bars	12	10	10	32
High bar	10	10	6	26
Support feet	14	14	9	37
Support arms	20	19	17	56
Hang	19	17	8	42
All-around Champion				
Floor	2	5	2	9
Pommel horse	1	6	3	10
Rings	4	3	1	8
Vault	4	2	1	7
Parallel bars	7	4	2	13
High bar	4	3	4	11
Support feet	6	7	3	16
Support arms	8	10	5	23
Hang	8	6	5	19

DISCUSSION

Number of gymnasts and number of nations participating at OG varies during observed period of time (Figure 1 and Figure 2). Greater declines are detected for OG 1932 (Los Angeles, USA) and OG 1956 (Melbourne, Australia) as many, mostly European countries were not of such economic prosperity to send teams so far away; e.g. Yugoslavia, France, Italy did not participate at least in one of them. After OG 1960 (Rome, Italy) number of nations systematically declined until OG 1980 (Moscow, Soviet Union), mostly due to political reasons. With the next OG 1984 (Los Angeles) (still due to political reasons) number of participating nations slightly raised and later rose until OG 1996 (Atlanta, USA), and again up to OG 2012 (London, UK), with slight decline at OG 2016 (Rio, Brazil). It is important to notice, that after OG 1988 (Seoul, South Korea), Soviet Union, Yugoslavia, and Czechoslovakia split into many smaller states, and this is one of reasons of increasing number of nations at OG afterwards. Until OG 1996 number of gymnasts and nations competing at all disciplines is the same, mostly because of selection of gymnasts towards OG and as the competing programme included optional and compulsory exercises. In 1992 in Paris (France) FIG organized the first World Championship per apparatus, which was a huge success for the development of the sport. Since then gymnasts are highly specialized into one up to three apparatus, which is recognized in Figures 1 and 2, that in all-around results list also gymnasts who competed at least in one apparatus are listed,

while on apparatus list of results are only those who actually performed on apparatus. Since OG 2004 (Athens, Greece), number of participants on vault dropped significantly, mostly with introducing the rule that those who want to qualify to vault finals, have to perform two different vaults. Consequently, with open-ended COP those with less difficult vaults do not even attempt to qualify.

Table 1 shows names of all medalist from observed period at all around competitions and apparatus finals. We can see there were 3 competitors in 92 years of Olympic history who won all-around tittle twice in a row: Viktor Chukarin in OG 1952 in Helsinki and 1956 in Melbourne, Sawao Kato in OG 1986 in Mexico City and 1972 in Munich, and Kohei Uchimura in the last two OG 2012 in London and 2016 in Rio de Janeiro. While in women artistic gymnastics is rare for a gymnast to compete at two consecutive OG (Delaš Kalinski, 2017) for men it is not unusual to compete at more than two consecutive OG. In the beginning of Olympic competitions, the dominant male gymnasts were from Germany, Sweden, Italy, and Switzerland, the countries where the sport first developed. By the 1950s, Japan, the Soviet Union, and the Eastern European countries began to produce the leading male and female gymnasts (Strauss, 2017), after 1984, also Chinese gymnasts took one of the leading part.

Up to OG in 1992 (in Barcelona, Spain) all-around gymnasts (Figure 3. to Figure 6.) were also very important contenders in apparatus events and almost all the time they were also very successful in winning medals on apparatus (between 35 and 50%). It is important to note, that despite limited number of apparatus specialists (except for World champions) at OG in Beijing 2008 (China), OG in London 2012 and OG in Rio 2016 (where medallists from last World Championship were allowed to participate at OG), the number of medals on apparatus for all-around gymnasts declined severely in all medal categories; gold, silver and bronze. Since OG 1992, apparatus specialists made an important role in development of this sport, while all-around gymnasts have less and less influence on apparatus. We can connect it to the pathway in track and field sport noticed in decathlon. Decathlon in track and field is similar to gymnastics all-around. Athletes compete in ten disciplines, while gymnasts in six. Olympic champion in decathlon has actually no chances of winning any event medal, as their results are far from the best specialists (IAAF, 2017; IAAF, 2017). Zurc (2017) discovered that in the ending part of gymnast's career, it does not matter to a gymnast, whether they have chosen to train and compete in all-around or specific apparatus, this is the path they would not change and would do it all over again. Despite the fact that in OG in Rio 2016 all-around medallists took three gold medals (Max Whitlock (UK) on floor and pommel horse, Oleg Verniaiev (Ukraine) on parallel bars) it is to acknowledge coaches brilliant planning. Olympic champion Kōhei Uchimura (Japan) despite him being well prepared and in excellent shape was not awarded with any apparatus medal. With efficiency of Olympic champions (Figure 7), we wanted to point out how champions were also taking part at apparatus events. The exact names of the all-around champions and their success at individual apparatus competitions are shown in the table 1. Besides all-around medal, gymnasts also have the possibility to win another medal on each individual apparatus, which can all together be six apparatus medals. As we consider six apparatus medal as 100% efficient gymnast, in whole gymnastics history only one gymnast achieved a perfect efficiency – Aleksander Dityatin (Russia, ex-Soviet Union) at OG 1980 in Moscow. The all-around Olympic champion from OG 1924 up to OG 1960 inclined their efficiency, with huge battle between Japan and Soviet Union gymnasts it declined until OG 1968 (New Mexico, Mexico), later rose again until OG 1980 and since then it declines again, and in last OG in Rio all-around Olympic champion was not successful winning medals on apparatus.

The last all-around Olympic champion with multiple gold medals on apparatus was Vitaly Scherbo (Belarus, ex. Unified Team of the ex-Soviet Union) who won 5 medals – 4 gold and one silver at OG 1992 in Barcelona. The last all-around champion who also won gold apparatus medal was Aleksei Nemov (Russia) at OG 2000 in Sydney who was also the best on horizontal bar.

When analysing which apparatus medals have mostly been won by all-around gymnasts (Table 1.) it is to notice, that apparatus with support on arms were dominant comparing to hang and support on feet apparatus. Results on parallel bars are by far most dominant where all-around medallists and Olympic champions were most successful. Comparing these results to research of Čuk and Forbes (2010) it seems that movements on parallel bars, which contain mostly combinations of rotations around longitudinal and transversal axis in support, upper arm support and hang, there is also certain amount of acrobatic flight elements; basically determine the ability also to control gymnasts own body on other apparatus. On the other side vault is also interesting, where all-around medallists and Olympic champions are less successful. Small amount of medals on vault mostly shows all-around gymnasts are focused on all-around results and with one good vault they can win all-around title, while to be good at vault gymnasts need to perform two different difficult vaults, where it can be seen it is something all-around gymnasts do not or cannot give special attention to as it requires too much work. Last all-around OG medallist winning also the vault medal was Alexei Nemov (Russia) at OG 1996 in Atlanta.

CONCLUSIONS

Number of gymnasts and participating nations at OG during history changed. It is important that number of participating gymnasts is stable for last decades while, number of participating nations is growing. It is important to notice that number of all-around gymnasts is dropping, while number of apparatus specialists is rising. From the whole history of artistic gymnastics for public, winner in all-around is considered as the king of gymnastics. In the past all-around gymnasts were also very successful on apparatus, but since the first World Championship for apparatus specialists in 1992 their success on apparatus is descending. All-around gymnasts are becoming slightly more and more similar to decathlon athletes, where Olympic Champion is not among the best in specific disciplines. With results of our research, gymnastics community could easier decide for further directions for the development of our sport.

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AGE PERCEPTION AND SPORTS CAREER IN THE WOMEN'S ARTISTIC GYMNASTICS

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Original article

Abstract

Women's Artistic Gymnastics (WAG) is an Olympic sport that has produced young girls celebrities over time, which has been extensively criticized for producing "little pixies." The present research was generated by the project "Coming of age: Towards best practice in Women's Artistic Gymnastics" (Kerr, Barker-Ruchti, Schubring, Cervin, Nunomura, 2015), whose focus was to analyze the experiences of older gymnasts and the factors that contributed to the prolongation of their career. The participants of this study were former gymnasts and are still active in Portugal, at the high level. We conducted a semi-structured interview to collect participants' reports and the thematic analysis was used as data treatment. The perception of becoming physically older was the most difficult fact to manage among the majority of respondents. The experience of being "older" gymnasts has helped them to understanding how particular contexts happen and thus face the challenges of the new phase of their careers. The factors that influence the development of the career have been to soften the myth that mature women would not compete internationally in the WAG; to propose alternatives for training in order to preserve the general health of gymnasts; propose guidelines for the management of the sports career. In short, we bring about future research into what could be done, which should not be done; or what should be avoided, by coaches, gymnasts and stakeholders in general to further the career of WAG gymnasts.

Key words: *Women's artistic gymnastic, body; extended career.*

INTRODUCTION

The Women's Artistic Gymnastics (WAG) is an admirable sportsmanship that attracts audiences to the spectacle, in which gymnasts demonstrate strength, daring, and aesthetics.

There are, however, misguided orientations reflected in an inappropriate attitudes and procedures that could compromise the integrity of the development of children and young people, which would cause irreversible harm and lead to the withdrawal of practitioners even when very young. This situation is due to the fact that infants and youngsters are not rarely subjected to an intense training load requiring early results in the competition.

Until the late 1960s, WAG consisted of mature women dominated by the balletic and feminine style (Kerr, 2006). During the 1970s, however, the

performance and did not awake to the fact (Barker-Ruchti, 2009). Thus, the sport has been extensively criticized for the production of "little pixies" as successful athletes instead of adult women (Kerr, 2006). And, particularly since the appearance of Olga Korbut and Nadia Comaneci, when gymnasts gradually became younger and smaller.

WAG is commonly understood as a sport which whose onset is precocious, intense training occurs during childhood, and high performance is achieved before adulthood (Nunomura et al., 2010, Bergeron et al., 2015, Barker-Ruchti et al., 2016).

We have observed that older gymnasts have already been in high performance at WAG, but in the last four decades the sport has moved further away from this reality, and the emphasis on high difficulty movements and acrobatization, provides the main context for analyzing changes in the bodies and the styles of practiced gymnastics. It was common for

14-year-old gymnasts to achieve international success, and even the International Gymnastics Federation (FIG) did not wake up to the fact (Barker-Ruchti, 2009). Today, we find that there are older gymnasts, 25 or over 30 years of age, experiencing a longer career. Our greatest example is the gymnast Oksana Chusovitina, currently 41 years old and who became the longest female gymnast in history (Mujika, 2012). A study by Atiković et al., (2017), on the age structure of men and women participants at the Olympic Games and at the World Championships from 2003 to 2016, pointed out that the average age of gymnasts in WAG and MAG has increased. Male gymnasts are on average older.

The FIG has responsibility for regulations and publications that guide gymnasts, coaches, and referees in the preparation, composition and evaluation of the series in all events. Over time, the FIG has suffered due to the diverse criticisms and health problems of the children and adolescents involved in the high performance in WAG. Thus, the entity began to require the minimum age of participation of 16 years for official international competitions as of 1997 (Kerr, 2006, FIG 2017, article 5.2.pg.37).

The purpose of this article was to understand and discuss the perception of the factors that led to the prolongation of the career in the WAG in Portugal.

Perception of getting older by the lens of cultural theory of learning

Hodkinson et al., (2008), present the "cultural theory of learning", which proposes to explain how and why the situation influences learning, and the cultural context is the central concept.

The authors' concern suggests that culture is (re) produced by individuals just as individuals are (re) produced by cultures. These learning cultures are highly synergistic and effective. Having a cultural view of learning that decentralizes conceptual change and cognition its social context and develops robust ways of integrating the individual and the situation into a learning process. In WAG, with the appearance of Nadia, a new style of gymnastics was established and that shaped the new culture of this sport, that is, smaller, lighter and androgenic girls would have more success in the spectacle-acrobatic style; so they would need to specialize earlier, usually before reaching menarche.

Thus, individual learning, through its social context, that is, the experiences of being "older" gymnasts, helps to understand their particular contexts, and then to develop a new phase of the career and deal with this transition.

By transcending individual and cultural learning situations, cultural learning theory offers a perspective to understand how gymnasts in a culture strongly linked to high- performance children's sport have been able to extend their careers into adulthood. In addition to breaking the paradigm established culturally in this sport, these older gymnasts need to understand learning as

part of a long life process, it would also be to learn to accept the new body and learn to deal with this change.

This perspective proposes that learning is the construction of identity in different situations, such as the context or environment in which learning occurs, and Hodkinson et al., (2007; 2008) use the metaphor "to become." Becoming is understood as a continuous and ubiquitous process of learning, of how particular practices impact on learning.

According to Barker-Ruchti et al., (2016), the cultural perspective of learning presents dimensions, the idea that learning occurs throughout life, as in the long term, the perspective of career development, involving practices, interactions and communication. The WAG culture is based on the challenge of a career ending in pubertal development, athletes are shaped by the sports culture, and the learning process is influenced by reflexive interactions between structural, situational, social, cultural and individual factors between the environment and the individual.

In these recent studies by Hodkinson et al., (2008) and Barker-Ruchti, et al., (2015), individuals move through life stages and can be seen as a product of learning that occurs in the interactions that are established between the learning individual and the other mediators of his or her culture, that is, parents, coaches, and several others that are important in the process of knowledge construction.

METHODS

The project was approved by the Human Ethics Committee of the University of Lincoln (HEC 2013-42). Participants of this study were gymnasts from Portugal, distinguishing themselves as the first and the second group of former high-performance gymnasts who were at least 20 years old at the time of their active career, being the first group participants of the decade of the Olympic cycles of 1984 and 1998; the second, Olympic cycles 2008 and 2012. The third, gymnasts who are still active above the age of 20 years of the 2012 and 2016 Olympic cycles. The high-performance competitive level was chosen because the training requirements and performance targets are more intense in this level of the gymnastics.

Data collection took place through a semi-structured interview, divided into three sections: a) oral history approach (Denzin & Lincoln, 2005) for the production of information about the trajectory of the gymnastics career; b) thematic approach (Flick, 2005) that focuses on the ideals related to age, body and training; c) reflective approach (Miethling & Krieger, 2004). There was an image of a sexually immature young woman and another image of an older, sexually mature gymnast, so that each subject would comment on the content of each image. The analysis was focused on the narratives of their experiences in an attempt to identify how contextual and individual factors influenced the evolution and maturation of gymnasts and the consequences these factors had for the future learning (Sparkes & Smith, 2014).

The interviews were transcribed verbatim and the free and axial coding procedure was used (Hammersley & Atkinson, 1995) to extract themes: factors that prolonged the career of gymnasts; normative perceptions regarding age, body, training and performance. Data analysis was conducted through thematic analysis (Ryan, Bernard, 2000; Braun & Clark, 2006).

RESULTS AND DISCUSSION

Historical background of the WAG in Portugal and its cultural particularities

In the Portuguese Gymnastics Federation there is a Technical Committee, usually composed of the coaches who decide on the ranking of the gymnasts in the high performance, on the selections of national representations, by judges more graduated and some people with relevant curriculum for this sport. This has the role

of discussing and presenting proposals for action for this sport.

The gymnasts are divided into 1st division and the division of base. In the 1st division, the gymnasts follow the FIG regulations for the competitions.

The participants of the present study began their practice in the WAG when they were children and had as main support the family, being the parents main incentive of the continuity of the sport and financing of their careers. Their influences were mainly the parents, coaches, other gymnasts with international reputation. According to the reports:

E5: *My mother enrolled in gymnastics when I was 3 years old, after that I developed a taste for the sport, until I got to the national and then international championship.*

E1: *I started with 7 years old. It was my parents who thought it was okay for me and they always did everything I could to continue my practice.*

E2: My coach influenced my career, and then clearly I loved Nadia Comaneci.

E3: *My parents influenced me, my mother is a gym teacher and since I know I walk in a gym.*

All were involved in the 1st division throughout their career and succeeded in the WAG, and were national champions, participated in European Championships, World Championships and Olympic Games. The transition from the initial phase to the middle and adult stages was somewhat easy, and was accepted by both the family and the gymnast.

At the beginning of sports practice of the young the family becomes determinant for the entrance and the stay in the sport, which, besides financing the expenses from the practice, are the main motivators for the development of the talents and the search for excellence (Nunomura, Oliveira, 2013).

In WAG, the role of the family is more commonly in the stage of childhood, the daily life of sports initiation is directly linked to the family in persistence, self-esteem and motivation, since the family presents a primary social environment (Samulski, 2009). According to reports, there was no negative involvement of family members:

E3: *I started to have training or small gym classes at age 3 and I entered in training of competition from the 5 years. My most influential parents in my career and motivated me all the time.*

E2: *I went to the gym because my Uncle / Godfather did gymnastics and so he put me in the gym.*

E1: *Naturally my parents, because they were the ones who took me to the gym. And they always did everything for me to continue my practice.*

Family support was a preponderant factor for the progress towards high performance, financial and motivational support also contributed to the athlete's development and to his/her permanence (Salmela and Moraes, 2003). The perception of the arrival of the age passes through the support of the family and was witnessed in this study mainly in the initial phases (Winner, 1998, 2000, Chagas, 2007).

The perception of the older age

The WAG has changed in recent years with respect to the judging system and in the format of competitions and, since the turn of the century, the population of female gymnasts at the highest competitive level has 'aged' (Barker-Ruchti, et al., 2015), according to reports: E4: *I thought I was older at age 17, I was seeing everything with different eyes, I went further, I followed the trainings that at this age many stop. I think it was a divisor, I think we started to have more responsibility in our training, to be examples for others.*

E2: *The arrival of the age realized when I had finished the normal course and start my professional life, was a divisor, in training or professional career, I went up to the Universiades.*

E3: *From a certain point the chip was changed, the reasons for stopping it were left out and the will to continue prevailed.*

WAG's aging population offers a unique opportunity to consider how such a career advancement from a culturally child sport would bring knowledge to the establishment of more effective practices that would further and further the athletic career (Barker-Ruchti et al.,2015). Several studies have raised the question of the perception of the arrival of age as important and significant in WAG (Nunomura, 2009, Barker-Ruchti, 2009, Nunomura et al.,

2010, Kerr et al., 2016). This perception of becoming older passes through different transitions, according to the report:

E6: *I think from the moment we pass the age favorable for this sport, but still we continue our colleagues take us as examples, I do not feel older just with more time*

E7: *We are more autonomous, we are aware of what we need to work to become better athletes without having to always have the coach to look at, whereas when we are younger we always need to have someone to see.*

The Theory of Social Representations (Moscovici, 2003), which objective is to provide a differentiated look at the individual and the collective. The purpose of the social representation is to abstract the meaning of the world. The theory allows us to understand social representations as almost tangible entities, they circulate, through a word, gesture, in our daily life (Moscovici, 2010).

The theory helps to understand the perception of getting older insofar as they involve aspects related to the subject's history, its culture, beliefs, values, ideologies, attitudes, affectivity, among others. In this perspective, social representations are the understanding about daily life, the interrelation between subject and object, and how the process of knowledge construction occurs under the guidance of concrete social contexts of the WAG in Portugal. Comments indicate that the perception of the mature age passes by moments in a combination of individual factors and social influences:

E5: *As I mentioned earlier, over time the group has been increasing and younger gymnasts have been arriving every year. At that time I began to perceive gymnastics goes a long way by being able to surpass our abilities, getting older we come to think of it.*

E4: *I think getting older, we begin to have more responsibility in our training, often the younger ones ask us for help during the training, I think they have us for reference, let's understand.*

In the course of his sports career, the athlete undergoes several phases, arising both from the personal development and learning stages of the sport, and from his own life history (Samulski, 2009), and the "social context change" (Moscovici , 2010). Thus, the individual and collective relations before the social reality of their times in learning the cultural context, makes us reflect on how we act in our daily lives, how we think and the implications of our way of thinking.

Puberty a key perios of transition

Adolescence is considered a key period when athletes undergo several transitions that can be identified as shifting from sport initiation to more intense training and high performance. Numerous individual factors such as the maturation stage, age, difficulties with the technical team and social influences that would constitute these transitional actors.

WAG is considered a competitive modality where the peak performance happens at much lower ages, which could promote the occurrence of early specialization (Baker & Côté, 2006, Nunomura, et al., 2010). Thus, the adolescence phase, considered as a strong point in the transition to adulthood, is a period marked by the search for identity and permanence in this sport.

Some factors that would contribute to the early dropout of the WAG are commonly found in the pubertal phase, and consist of the very rigid

organization of the training processes; the monotonous application of excessive system loads; competitive failure and stagnation in the achievement of results; in performance, in training saturation; weight gain; the most common injuries lesions; which result in discontent and thus demotivating us to move forward at this stage.

The interviewees point out that this phase was highly relevant, as follows:

E3: *I became a teenager who was heavy and had difficulty managing weight and training. The drastic changes these phase were the most difficult, but as in everything there is to be aware of what is happening and try to work to improve.*

E5: *Many girls as they enter puberty are faced with a whole world of opportunities to make new experiences. It is up to them at that point to set priorities, which are often not gymnastics. On the other hand, we always have the injury factor that can also arise at this time, if there is an excessive training load at earlier ages, which happens more often than we imagine.*

Gymnasts categorized pubertal development as a difficult phase, mainly due to the body changes and the effects they had on performance (Barker-Ruchti et al., 2011).

The perception of bodily change in adolescence becomes important for the gymnast and her coaches, as the age advances, the changes are visible, but more difficult to obtain performance success due to these changes and to the aging of the organism. The way the interviewees perceive these changes in their body image, ie, negative feelings about body weight and shape, causes physical and mental stress, and feeds an environment of possible abandonment. On the contrary, this scenario could generate the strength to overcome this moment and, thus, to promote the longevity of the race, according to the reports:

E3: *From 12 to 13 years I gained 10 kg. I was quite lean and strong at age 10, but at 12 I had an injury, I was out 1 year. I became a teenager who was heavy and had difficulty managing weight and training.*

E5: *At 10 years of age, I gained weight very easily. The exercises became more difficult to perform mainly, since the strength gain was not proportional to the weight gain. When we are heavier, injuries begin to emerge much more easily. I had difficulty gaining muscle mass and my body was different that bothered me.*

E1: *When I started to practice gymnastics I was quite thin. With menarche, I became heavier.*

The understanding of social and internal relations during the period of puberty brings a new look on the subjects that we propose to understand, and to communicate with the social reality that surrounds the WAG.

Contrary to what has been observed in most studies conducted in other sports in several countries, the results obtained in this study demonstrate that the reality of WAG in Portugal is characterized by an expressive use of the performance of athletes who, at very young ages, are able to achieve benchmark national results and have managed to maintain a solid hegemony throughout their careers up to the age of seniors.

The perception we obtained in the present study was that, collectively, the gymnasts felt that from the moment they understood the "awkward, difficult" phase, they were able to continue their career in the WAG. The factors of support or charging of the coaches, the individual perception, and the understanding of the injuries, facilitated the transition from puberty to adulthood. The perception of the bodily change was detected, mainly, in the physical part. Some of the gymnasts reported this fact:

E2: *at age 10 he was thin and at 20 was much heavier, but he had developed a lot of strength for the body he had.*

E3: *drastic changes in body perception were the most difficult to understand, but since everything has to be aware of what is happening and try to work to improve ... It is important to realize that these changes*

(in my case) were normal and relative to the growth and development of my being. Changes were the most difficult in terms of the relationship with the body.

There are gymnasts who perceive these changes only as minor bodily changes, such as the respondent explained:

E4: *my body did not undergo major changes, I could not perceive in this drastic way the exchange of child, young, adult, because weight gain and small modifications are normal. I realized in fact change after I left the gym.*

The gymnasts indicated that in this transition phase there were unexpected and even undesirable effects, such as injuries, considerable increase of weight, nonconformity with these changes. On the other hand, they had support, both from coaches and people outside the gym as well as family members. The fact allowed them more self-knowledge and created self-responsibility, that is, control their knowledge process over information acquired over time and become learning skills.

Training as a perception of a change factor

In the WAG, systematic training begins before puberty. The study with sporting coaches, about the age they consider to be ideal for the beginning of the practice and the specialization and the respective arguments, revealed that the training practices begin at an early age (Nunomura, et al., 2010).

For the gymnasts of this study meant initially having the perception of simple, basic training and, over time, realized the exigency, training was increasing. Over time, the hard times were evident in the long hours of training each week, in the injuries that occurred, in the abdication of many personal factors, in the demands for success in the competitions, as the gymnasts described:

E2: *Training takes a lot of effort, sacrifice and fighting every day. There are always difficult times in practice. After injuries then it is hard and reconcile University with the training, for me it was very difficult.*

E5: *At first it seems easy. Over time, the difficult times were many. The gym goes a long way to being able to overcome our abilities, full of failures and obstacles that we have to learn to overcome. On the other hand, we trained many hours a week, which meant that we had to give up many things that would be trivial for teenagers of our age (going out with friends, parties, etc.) and sometimes the decision to give up was not easy.*

The training at puberty did not represent a career end point, but a temporary phase of learning, which had important application for its motivation, and strength to continue as reported:

E3: *I became a heavy teenager, sometimes technical evolution did not exist. He could see that he was not advancing in the technical field, and it was difficult to carry on. I had to have the patience to perform a physical job and have the strength to continue.*

E4: *At the age of 15 I realized that I was afraid to perform certain exercises. At 17, when I realized that I was older, I was already seeing everything else, including training.*

Body perception, mainly from puberty, has shown that it does not have end-of-career characteristics (Barker-Ruchti, et al., 2015), but it is shown that the dispositions to learn can transform in a short period of time and that such transformations are often linked to complex ways to broader social, economic and cultural contexts.

The interviewees talked about how these older horizons made them learn different health care, their relationship with the coach and their perception of more effective and productive training (Barker-Ruchti et al., 2016).

CONCLUSIONS

Manuscript proposes to understand the perception of the factors that favor prolongation of the career in WAG.

The growing perception of the return of senior high-level gyms in the WAG international arena is evident, prompting us to reflect on how this new phase of the career could bring values, ideas and practices to new discussions about effective construction and environments friendly to gymnasts.

Interviewees pointed out that the acceptance of mature age makes them see the longer career in a combination of individual behavioral factors, bodily changes and social influences.

For such a demanding sport, it is recommended that further research foster discussions about the acceptance of age and bodily changes in WAG as natural for agents. And from that, think of the adjustment of planning and training to accommodate these changes, instead of excluding them from the system, if they still wish to continue.

At WAG, this implies changing coaches' view on gymnasts who have advanced from infancy to adulthood; their potential should not be discarded if they are still able to perform at the highest level.

The results achieved in this research are not intended to lead to linear understanding, but to provoke discussions about the experiences of "older" gymnasts, and to bring to the fore the concern with internal social relationships, procedures practiced, and coaching at WAG.

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Photo abowe: Opening ceremony of XVI all Sokol Zlet in Praque, 100 years since Čzechoslovakia as state have been recognized

Photo below: Ing. Vladimír Holčík, starosta Sokolskej únie Slovenska, Sokol union of Slovakia

HISTORICAL CHANGES IN HEIGHT, MASS AND AGE OF USA WOMEN'S OLYMPIC GYMNASTICS TEAM: AN UPDATE

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Original article

Abstract

Nearly every modern Olympic Games has brought astonished comments and criticism of the body sizes of female gymnasts. The comments from laypersons, scientists, journalists, and physicians too often imply that these diminutive athletes are unusually small and possibly unhealthy. Purpose: An extended and updated analysis of the sizes of U.S. female Olympic gymnasts including the 2012 and 2016 Olympic Games. Methods: Official public records from the US Olympic Committee and USA Gymnastics of Olympic team members were assessed including height, mass, age, body-mass index (BMI) and team performance rankings. Sixteen Olympic teams with a total of 123 team positions including the alternates were assessed. Trend analyses were conducted using linear and polynomial models. Results: Analyses indicated that since 1956, height, mass, age, and BMI declined at first and then increased, with the exceptions of height and rank. Best regression fits were obtained via 2nd order polynomial equations. Height and rank showed a downward trend throughout the historical period. Conclusion: Female Olympic gymnasts were getting smaller through approximately the 1980s and early 1990s. An upward trend in size variables was then observed through 2008. The addition of the 2012 and 2016 Olympic Games data showed that height shifted to a decline from a slight upward trend, and rank continued to decline throughout the historical period.

Key words: *trends, anthropometry, gymnastics, body size.*

INTRODUCTION

Women's gymnastics has risen to become a mainstream sport with all of the attention, fan interaction, ill-informed criticism, and speculation such status entails. As such, the diminutive size of these athletes continues to garner attention in the press, social media, and the scientific literature. Recent discourse on the size of 2016 champion women's gymnasts included some body shaming and sexism on Twitter that resulted in a quick retort, "They're Olympians, they didn't work out to be attractive or for our approval they did it to win Gold" (Blair, 2016). Images that show Simone Biles standing next to an Olympic volleyball player and the famed Olympic

swimmer Michael Phelps serves to demonstrate how small these athletes are (Moss, 2016). Controversy over whether gymnastics training stunts growth also continues to swirl (Malina, 1996; Malina et al., 2013; Moss, 2016). Journalists and scientists have openly questioned whether female gymnasts are unhealthy because of their size and low body weight (Finch, 2016).

Those of us who have been involved in gymnastics for many years find these discussions inane and illogical. "Female gymnasts are characterized by short stature, appropriate mass for stature, late maturation and an ectomorphic-mesomorphic somatotype." (Malina, 1999; Malina et al., 2013) p 291. Lay literature dwells on the size of gymnasts while usually also adding what incredible athletes they are (Epstein, 2016; Finch, 2016; Foster, 2016; McDonald, 2016; Mooney, 2012; Moss, 2016; Mushnick, 2016). However, serious misconceptions remain. Body size and performance characteristics were not predictors of gymnastics drop-outs after controlling for age (Claessens & Lefevre, 1998). The authors hypothesized that social and psychological factors were to blame rather than size and shape (Claessens & Lefevre, 1998). Others have indicated that the small size of gymnasts presents a significant advantage in moving their body through difficult acrobatic maneuvers, "Muscle strength is related to cross sectional area, and therefore total volume (and mass). In other words, the bigger you are the more muscle you need, and since gymnasts work by moving their bodyweight, it is an advantage to be lighter" (McDonald, 2016). A similar argument could be made for tall stature among basketball and volleyball players that extraordinary height serves these athletes. Perhaps a "just-so" story, but a sport scientist was quoted, "For the most part, female gymnasts are short because it's harder to be good at a lower level if you're tall … so the tall ones weed themselves out early and we don't see them on TV at the Olympics" (McDonald, 2016). The hormonal changes accompanying adolescence also have been considered in the natural development of the pubescent and post-pubescent female athlete. However, the hormonal milieu is generally normal relative to the skeletal age of the gymnasts (Malina, 1999; McDonald, 2016; Wulff Helge & Kanstrup, 2002).

Many opinions and writings on female gymnasts appear to be immune to scholarship and facts. Our previous study of Women's Olympic Teams from 1956 to 2008, showed that while there was a period when Olympic gymnasts were indeed getting smaller, the most recent information has contradicted this idea (Sands, Slater, McNeal, Murray, & Stone, 2012). Yes, female gymnasts are small, but is there reason to believe that U.S. Olympic gymnasts are continuing to shrink? The lay press and journalists still believe gymnasts are getting smaller (Epstein, 2016; Mushnick, 2016; Ward-Henninger, 2016).

The purpose of this continued investigation was to update the information on size, mass, age, and team rankings of U.S. Women's Olympic Teams in artistic gymnastics. This study builds on previous work examining the characteristics above with Olympic teams from 1956 to 2008. Two more Olympic Games have been held since the completion of the last study, 2012 – London, and 2016 – Rio de Janeiro.

METHODS

***Subjects*:** Sixteen women's Olympic gymnastics team records were examined. The dataset included both the competing team members and alternates (N=116). Team rosters ranged from five to 10 members, depending on the selection policies and international rules for each Olympic team. Seven team members were most commonly named, with six who actually compete, and a seventh who was the official alternate. However, team selection policies have varied depending on USA Gymnastics' rules and policies regarding team selection, which are secondary to the international competition format as set by the International Gymnastics Federation (FIG, Fédération Internationale de Gymnastique). More

recently, the International Olympic Committee has set new policies for the number of members involved with each team and sport, and the FIG has followed suit (Federation, 2015). The last two Olympic Games involved six (2012) and then five team positions (Rio de Janeiro) (Federation, 2015). The number of team athletes will be further reduced to four athletes in the 2020 Games.

The U.S. has used various methods to establish the team that actually goes to the Olympic Games. There have been official alternates who attend the Games representing the U.S. and usually receive a modified credential for access to the competition arena. The U.S. often has included additional alternates creating an Olympic team "squad" that was later evaluated at a pre-Olympic training camp in order to determine the rankings and the actual Olympic Team.

The Olympic Games for women's gymnastics were not continuous through the historical period described here, with a notable boycott in 1980 by many western countries. Fortunately, a team was selected in 1980, but no final team rank was available. Moreover, the minimum age rules changed in 1980 and again in 1997. The minimum age prior to 1981 was 14y, and in the interim to 1997, it was 15y. Current rules demand that senior, international-level gymnasts be 16y in the calendar year of the particular international contest (e.g., Olympic Games, World Championships).

Procedures: Official U.S. Olympic Committee (USOC) and USA Gymnastics (USAG) records were surveyed, and the self-reported age, birth date, height, and weight for each Olympic-team athlete were recorded from paper documents from 1956 to 2008. The 2012 and 2016 Games followed a closing of the USOC Sport Information Center Library. USA Gymnastics has not continued to maintain these types of records following 2008. Ironically, data on height, weight, and age were culled from various journalistic sources for the 2012 and 2016 Games. Height and age information was readily available for all of the athletes from the 2012 and 2016 Games. Weight information is more culturally sensitive and we were unable to find publicly available sources for two athletes' weight. All data were obtained following the requirements of the U.S. Olympic Committee on the study of human subjects/athletes. Moreover, these data were publicly available from the official records located in the USOC archives at Olympic Training Center in Colorado Springs, CO, USA. Body mass index (BMI) was also calculated for trend comparisons.

Statistical Analysis: Updated group means for each team are presented in Table 1. Descriptive statistics are presented for the athletes on each team in Figures 1-5. Linear and curvilinear regressions were used to determine the best least squares fit to the time-series of variables addressed in this study. Two time-series analysis methods were calculated and fitted to the historical data along with the resulting regression equations, 95% confidence intervals, and r^2 values using Microsoft Excel 2016 (Redmond, WA, Version 1710) and ProStat (Version 6, Pearl River, NY). The best regression model fit to the historical data was determined by the highest r^2 value.

RESULTS

Table 1 shows updated descriptive information regarding the Olympic Games, the number of U.S. athletes involved with each team or training squad, variable, and the final team rank. Table 2 presents the updated equations for the least squares best fits of linear and polynomial regression equations and associated r^2 values. Figures 1 through 5 show the time-series of the means for each team and variable with standard deviations and the final U.S.A. team ranks for each Olympic Games. Figures 1 through 5 also show the second-order polynomial fit curves. Note that the general trend over time does not appear to be a simple linear relationship (see Table 2). The more recent Olympic Games show an upward trend in height, mass, age, and BMI.

Also, note that the overall curve of body size trends is reflected to a degree in the Olympic team final placement ranks.

Table 1
Updated Descriptive Information - All Women's Olympic Gymnastics Teams 1956-2016.

Olympic Games	N	Height (cm)	Mass (kg)	Age (yr)	BMI	Team Rank
1956	7	161.8 ± 7.6	55.6 ± 3.7	19.4 ± 2.6	21.3 ± 1.9	9
1960	10	158.4 ± 4.6	51.2 ± 3.9	19.0 ± 1.9	20.4 ± 1.5	9
1964	7	156.8 ± 4.1	49.0 ± 2.2	19.9 ± 3.4	20.0 ± 0.8	9
1968	8	158.4 ± 5.1	49.6 ± 5.2	17.4 ± 1.9	19.7 ± 1.7	6
1972	7	158.6 ± 4.9	47.4 ± 2.3	18.9 ± 3.3	18.9 ± 1.0	4
1976	7	160.6 ± 2.4	48.2 ± 3.4	17.9 ± 1.2	18.7 ± 1.0	6
1980	7	149.1 ± 4.3	40.2 ± 3.9	15.7 ± 2.7	18.0 ± 1.1	NA
1984	8	152.8 ± 5.8	43.6 ± 4.0	18.1 ± 3.0	18.6 ± 0.9	2
1988	7	152.4 ± 7.2	42.6 ± 6.2	16.9 ± 2.0	18.2 ± 1.2	4
1992	7	146.2 ± 9.4	37.7 ± 4.9	16.3 ± 1.4	17.6 ± 1.0	3
1996	7	150.0 ± 6.9	41.6 ± 5.2	18.1 ± 1.7	18.4 ± 0.9	1
2000	8	154.2 ± 4.1	47.9 ± 5.1	19.1 ± 2.6	20.1 ± 1.7	4,3*
2004	8	152.1 ± 4.2	45.3 ± 3.5	19.0 ± 4.4	19.9 ± 1.2	2
2008	8	153.0 ± 7.0	47.5 ± 5.7	18.0 ± 2.0	20.2 ± 1.4	2
2012	8	158.5 ± 5.9	48.5 ± 5.3	17.0 ± 2.6	20.1 ± 1.7	1
2016	8	151.3 ± 7.6	49.0 ± 2.2	18.6 ± 2.0	20.8 ± 1.6	1

NA = Non-participation
* = Originally 4th place, raised to 3rd place after discovery of Chinese age cheating.

Table 2
Updated linear and second-order polynomial regression equations for individual athlete data on each variable with Olympic Games year.

Variable	Linear Equation	r^2	Second-Order Polynomial Equation	r^2
Age (yr)	$y = -0.059x + 18.58$	0.06	$y = 0.029x^2 – 0.558x + 20.077$	0.30
Height (cm)	$y = -0.5078x + 158.96$	0.29	$y = 0.1048x^2 – 2.8886x + 164.31$	0.50
Mass (kg)	$y = -0.3363x + 49.407$	0.13	$y = 0.1804x^2 – 3.0428x + 58.606$	0.74
BMI	$y = -0.002x + 19.458$	0.00	$y = 0.0504x^2 – 0.8584x + 22.207$	0.81
Rank	$y = -0.5231x + 8.5654$	0.78	$y = 0.0428x^2 – 1.2467x + 10.66$	0.86

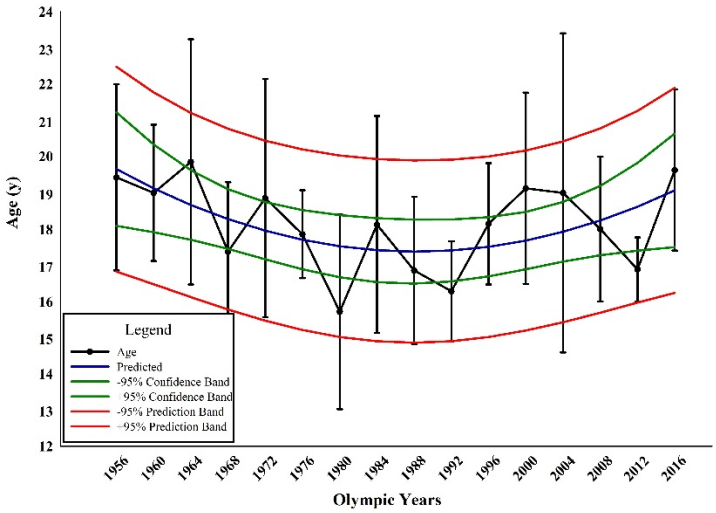

Figure 1. Updated means of age trends of the U.S. Women's Olympic Gymnastics teams from 1956 to 2016 with 2nd-order polynomial predictions and 95% confidence and prediction bands**.**

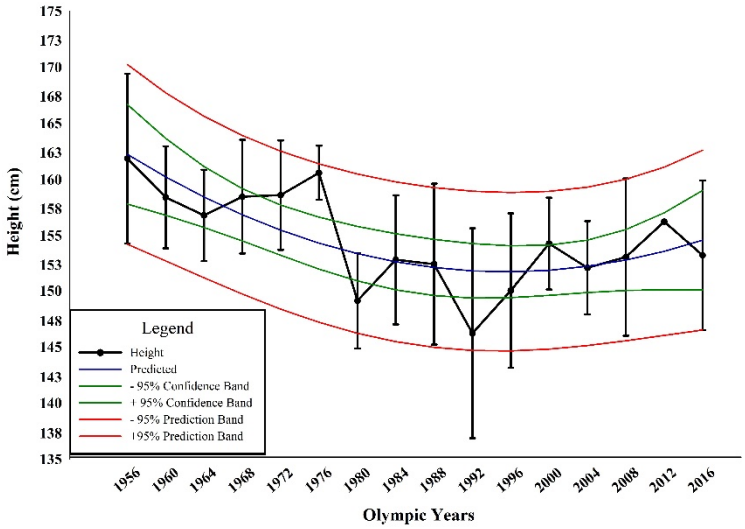

Figure 2. Updated means of standing height trends of the U.S. Women's Olympic Gymnastics teams from 1956-2016 with 2nd-order polynomial predictions and 95% Confidence Intervals. Note that the most recent Olympic team (2016) showed a decline in height from the 2012 team in spite of two members in common with both teams.

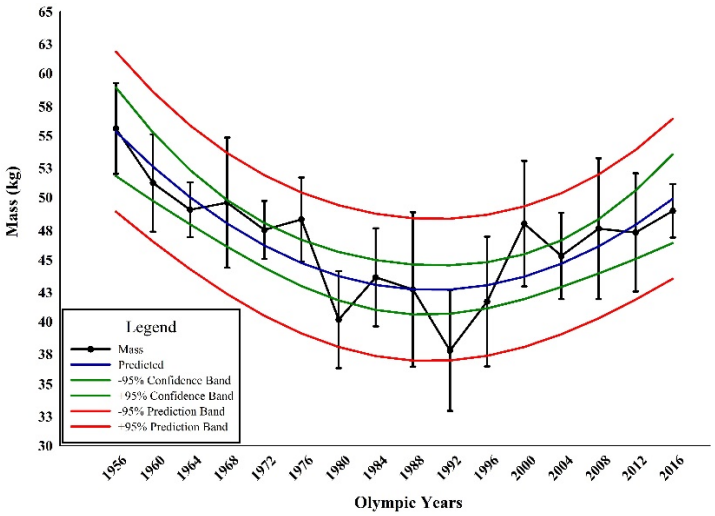

Figure 3. Updated means of body mass trends of the U.S. Women's Olympic Gymnastics teams from 1956-2016 with 2nd-order polynomial predictions and 95% confidence and prediction bands.

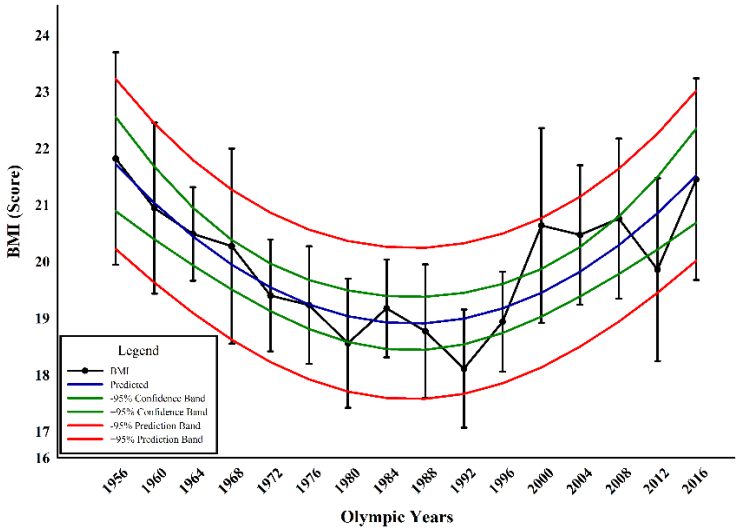

Figure 4. Updated means of body mass index trends of the U.S. Women's Olympic Gymnastics teams from 1956-2016 with 2nd-order polynomial predictions and 95% confidence and prediction bands.

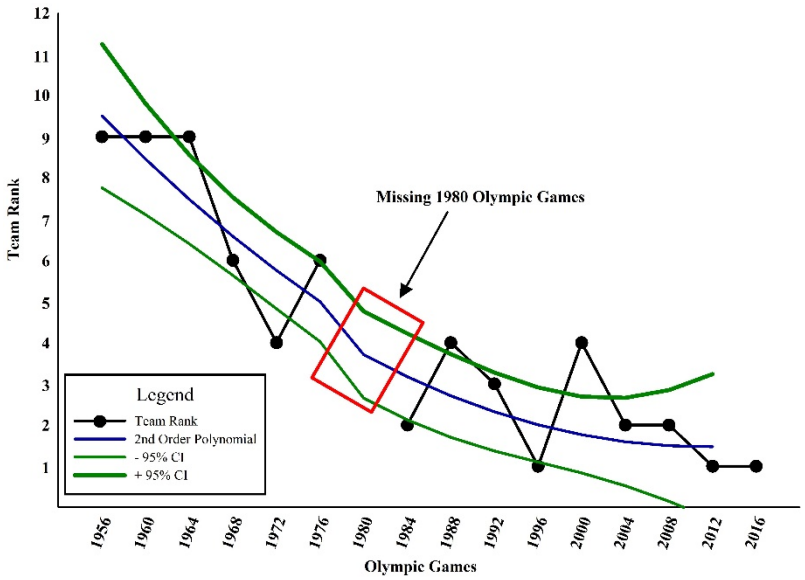

Figure 5. Updated team ranks trends of the U.S. Women's Olympic Gymnastics teams from 1956-2016 with 2nd-order polynomial predictions and 95% confidence band.

DISCUSSION

American gymnasts were getting smaller through approximately the 1980s and early 1990s. However, the most recent trend is increasing height, mass, age, and BMI. In keeping with the premise that smaller gymnasts are at an advantage, the Pearson correlations and polynomial regression analyses between the Games and height, mass, age, and BMI indicated that as the U.S. gymnasts became smaller, their Olympic Games final team ranking improved (Tables 1 and 2, Figures 1-5). A host of obvious reasons led to the conclusion that female Olympic gymnasts need to be small and light in order to perform their skills with the greatest efficiency and effectiveness (Ackland, Elliott, & Richards, 2003; Claessens, Lefevre, Beunen, & Malina, 2006; Sands, 2011; Sands et al., 2012). Evidence for a "smallness" factor in competition was provided by Claessens and colleagues showed that higher endomorphy scores were negatively related to performance scores at the 1987 Rotterdam World Championships (Claessens, Lefevre, Beunen, & Malina, 1999). However, the trend toward smallness cannot continue indefinitely, and as can be seen by the historical trends regarding size (Figures 1 and 2), U.S. gymnasts are not getting smaller in the most recent Olympic Games, covering 24 years (1992-2016), they are actually getting larger. Although as noted above, the most recent 2016 Olympic team had some very short members, even by gymnastics cultural norms (Finch, 2016; Foster, 2016; McDonald, 2016; Mooney, 2012; Moss, 2016). However, our data show that while gymnasts are small, they have not been shrinking for the past 30 years (Epstein, 2016).

CONCLUSIONS

Recent "body shaming" attacks on female Olympic gymnasts via social media have met with swift and aggressive responses indicating that the "shamers" opinions are not relevant (Blair, 2016; Kerr-Dineen, 2016). Malina has emphasized that, along with familial relationships, the selection approaches of the sport may be powerful determinants of the small size of elite, female gymnasts (Malina, 1996, 1999). For example, Malina has noted that records of height in early childhood have shown that young females destined for

gymnastics are small and light long before they are selected for training (Malina, 1996, 1999). Finally, the size of gymnasts appears to be an optimization problem rather than a minimization problem. The best U.S. Olympic Team finishes were accomplished when the teams were not the smallest, lightest, or leanest, but greater than the lowest recorded values. Female Olympic gymnasts have always been small, but most recently they have been getting larger.

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ROTATION SCHEMES OF THE BEST FEMALE GYMNASTS IN THE WORLD

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Original article

Abstract

Worldwide trainers ask if there is a rotation scheme, which improves the gymnastics performance and/or facilitates the learning of the elements with longitudinal rotations. Although there are some surveys and scientific publications on it, we still are seeking for more data to understand the undergoing relationships within the rotation habits of high-level gymnasts. In a recent study, the Men's Individual All□Around finalists at the Olympic Games Rio 2016 were categorized using the current classification system of rotational schemes. This study aims first to categorize the Women's Individual All□Around finalists at the Olympic Games Rio 2016. Furthermore; the analysis should help to improve the classification system by comparing both genders. We assume that the female rotation scheme should be more complicated due to the requirements of choreographic movements and gymnastic turns. In this context, the study aims to set a viable classification system for female gymnasts as well. The study revealed that 52% of the female finalists turn to the right while 48% prefer to rotate to the left after having crossed out the dance and gymnastic elements.

Key words: *laterality, rotational preference, rotation scheme, lateral consistency.*

INTRODUCTION

After many years of opinions and speculations about possible turning systems, in recent publications the recording of rotating schemes of gymnasts was systematized (Bessi, Hofmann, Laßberg, & Heinen, 2016; Schindler, 2016; Bessi, 2018; Pfeifer, 2018). This study aims first to analyze the Women's Individual All-Around finalists at the Olympic Games Rio 2016 regarding the preferred turning scheme analog the analysis of the Men's Individual All-Around finalists at the Olympic Games Rio 2016 (Bessi, 2018). Since the women are analyzed for the first time using the categorization matrix, we are looking for peculiarities that have to be considered to better understand the undergoing relationships of the turning habits of high-level gymnasts. We assume that the female rotation scheme should be more complex due to the requirements of choreographic movements and gymnastic turns. In this context, the study aims to set a viable classification system for female gymnasts as well.

To avoid misunderstanding, we want to start with some definitions.

Direction of Rotation: Defined from the perspective of the gymnast, a rotation to the left in upright stance corresponds to a backward rotation of the left shoulder and forward rotation of the right shoulder. When observing from above, the gymnast performs a counterclockwise rotation. A rotation to the right in upright stance is defined vice versa, i.e., a clockwise rotation when observing from above (see Figure 1).

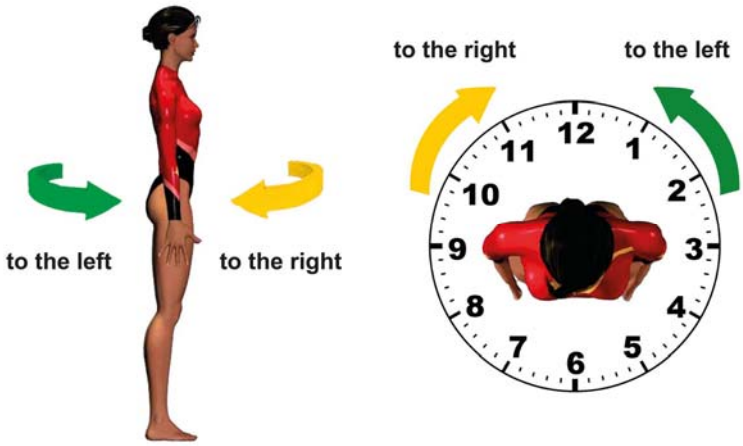

Figure 1. Definition of the rotation direction around the longitudinal axis.

Round-off designation: Since we used the round-off as an essential element to determine the turning system, it is crucial to understand that the designation of the round-off direction is the opposite to the rotating direction of the body. When performing a left round-off (i.e., putting the left-hand first on the floor, as shown in Figure 2) the gymnast rotates indeed to the right with her body around the longitudinal axis.

Figure 2. A round-off left is indeed a rotation to the right around the longitudinal axis.

Upright and upside down: Many publications and unpublished recordings have confirmed that there is a strong bias among gymnasts to rotate in upright stance in the opposite direction as upside down (Bessi, 2006, 2018; Coren, 1993; Heinen, Jeraj, Vinken, Velentzas, & Vinken, 2012; Sands, 2000; Schweizer, 2008; Wüstemann & Milbradt, 2008). Therefore, the determination of the state is fundamental before determining the direction of turn. However, until now the exact definition of

these two states „upright" and "upside down" is not set. Some Authors just divided the sagittal plane into two halves (Faber, 2018; Koscielny, 2009; Schindler, 2016). Rotations below the horizontal line on the sagittal plane are considered by them in upright stance and above the horizontal line as upside down. There is some evidence (and above all, the subjective feeling of many surveyed gymnasts) that the change in spatial orientation occurs later when the body is more vertical. Therefore, we want to introduce a practicable demarcation between the positions, which take into account this phenomenon. We propose to use a system that considers the position in the phase of initialization of the rotation about the longitudinal axis (Figure 3). All elements starting the rotation around the longitudinal axis in the green area are considered in upright stance even if the body is horizontal or slightly above the horizontal plane (for example like the right gymnast in the figure triggering the rotation to the right). All elements, which start a longitudinal rotation in the white area, are considered upside down.

Type of elements: We used as differentiation the terms "dance", "gymnastic" and "acro". *Dance* elements are all elements that are not included in the Code of points and that serve the choreographic design of the routines. *Gymnastic* elements are the leaps, jumps, hops, and turns. In this study *Acro* are all other elements, even if they could not be acrobatic elements in the real sense like a giant circle backward with 1/1 turn (360°) to handstand.

Figure 3. Definition of the state upright or upside down.

METHODS

Participants

The 24 finalists of the Women's Individual All-Around during the Olympic Games Rio 2016 (Organizing Committee, 2016) were examined with regard to their directions of rotation. The routines were analyzed using the videos of IRCOS® (Instant Replay & Information System).

We analyzed all routines of the finalists who finished the whole competition. The distribution of the analysed nations was as follow: USA (2), RUS (2), CHN (2), CAN (2), VEN (1), JAP (2), NED (2), SUI (1), BRA (1), ITA (2), GBR (1), FRA (2), GER (2), BEL (1). Unfortunately, the Brazilian

Jade Barbosa suffered an injury during the competition and could not finish it. So she was removed from the sample.

Instruments and procedures

The elements with rotation around the longitudinal axis of the 23 gymnasts, the direction of turning and the state upright or upside down according to the definition above were registered. In addition, we recorded for the first time the type of movement with the categories dance, gymnastic or acro according to the definition set above (Table 1). The reason is that previous research included only male gymnasts. Women artistic gymnastics has other requirements set by the Code of Points (Fédération Internationale de Gymnastique, 2016). Altogether, the gymnasts made a total of 686 elements with longitudinal rotations during the competition. We registered 361 acrobatic elements (207 to the left and 154 to the right); 79 gymnastic elements (35 to the left and 44 to the right) and 246 dance elements (142 to the left and 104 to the right) and as shown in Table 2 (Fédération Internationale de Gymnastique, 2012).

With these data, we determined which rotational scheme the gymnasts follow using a slightly modified classification system.

Basically, we use the classification system proposed in Bessi (2018), which has two basic pure categories: bilateral and unilateral consistent accompanied by the direction of turn, left or right (Figure 4). Nevertheless, we altered a detail regarding the number of elements that do not fit into the scheme. We propose from now the use of percentage numbers instead of absolute numbers to take into account that different gymnasts can perform different amounts of elements with rotation around the longitudinal axis. We found large differences in the amount of turning elements. For example, Louise Vanhille (FRA) showed 10 acrobatic elements with rotations around the longitudinal axis while Shang Chunsong (CHI) performed 21 elements.

Bilateral consistent rotation scheme (BC): A pure bilateral consistent rotating gymnast always rotates in the opposite direction around the longitudinal axis when being in an upside down position, as compared to when being in an upright position. The best way to identify the type of rotation scheme is to start observing the round-off and the back somersault with turn. Such a gymnast performs the round-off left (i.e., rotating right, as shown in Figure 2), and the twist to the left.

Unilateral rotation scheme (U): A pure unilateral rotating gymnast always rotates in the same direction, independent of the element or the body orientation in space. Such a gymnast performs, for example, the round-off left (i.e., rotating right, as shown in Figure 2), and a somersault backward with turn to the right as well.

Certainly, some considerations may lead to the decision that a gymnast has (or wants) to give up the preferred rotation scheme partly depending on the situation. For example, performing an acro line on floor a gymnast could change the direction of a salto forward with twist after a salto backward stretched with 1½ twist to take advantage of the ground reaction force produced by the antecedent movement. To consider these eventualities, we counted elements that do not fit into the scheme up to a maximum of 20% of all turning elements during the whole all-around. In this case, we weaken the pure basic rotational type by identifying it with the word *restricted*.

Restricted bilateral consistent rotation scheme (BCr): A restricted bilateral consistent rotating gymnast is basically a BC gymnast. However, she shows up to a maximum of 20% of all turning elements during the All-Around competition that do not fit the pure BC scheme.

Restricted unilateral rotation scheme (Ur): A restricted unilateral rotating gymnast is basically a U gymnast. However, she shows up to a maximum of 20% of all turning elements during the All-Around competition that do not fit the pure U scheme.

Table 1

Example of the registration. Here the records of Simone Biles (USA) on Floor.

Video position	Element [# in Code de Pointage]	Turning direction	Position	Type
00:26	Turn in Stand	left	upright	Dance
00:28	Turn in Stand	left	upright	Dance
00:31	Round-off [3.106]	left	upside down	Acro
00:32	Double salto backward stretched with 1/1 twist (360°) [5.803]	left	upside down	Acro
00:38	Turn in Stand	right	upright	Dance
00:41	Side split jump with 1/1 turn [1.307]	right	upright	Gym
00:44	Turn in Stand	right	upright	Dance
00:47	Round-off [3.106]	left	upside down	Acro
00:48	Double salto backward stretched with ½ twist [5.703]	left	upright	Acro
00:56	Turn in Stand	left	upright	Dance
00:59	Turn on floor	right	upright	Dance
00:59	2/1 turn in tuck stand one leg (double wolf turn) [2.407]	right	upright	Gym
01:01	Turn in Stand	right	upright	Dance
01:04	Turn on floor	right	upright	Dance
01:11	Split leap with 1 ½ turn [1.401]	left	upright	Gym
01:13	Turn in Stand	left	upright	Dance
01:19	Round-off [3.106]	left	upside down	Acro
01:20	Double salto backward tucked with 2/1 twist [5.802]	left	upright	Acro
01:27	Turn in Stand	left	upright	Dance
01:34	Switch leap with 1/1 turn in flight phase [1.404]	right	upright	Gym
01:43	Round-off [3.106]	left	upside down	Acro
01:44	Double salto backward tucked with 1/1 twist [5.502]	left	upright	Acro
01:48	Round-off with ½ turn	left	upside down	Acro
01:50	Turn on floor	right	upright	Dance

Table 2

Frequencies of turning elements in the different categories.

		Rotation		
		left	right	Total
Acro	upright	112	83	
	upside down	95	71	
	Total acro	207	154	361
Gymnastic		35	44	79
Dance		142	104	246

The terminology of pure and restricted rotation schemes should be preceded by the direction of turning in upright stance. Former analyses indicate that it is best to determine this by the direction of the backward twist. Therefore, the classification system has eight theoretically possible categories: left bilateral consistent (lBC), left bilateral consistent restricted (lBCr), left unilateral (lU), left unilateral restricted (lUr), right bilateral consistent (rBC), right bilateral consistent restricted (rBCr), right unilateral (rU) and right unilateral restricted (rUr) (see Figure 4). However, this is only theoretical as we will show in the next pages.

All gymnasts, who do not fit into the preceding categories, are labeled with *no distinguishable rotation scheme* (ND). At this point, it seems appropriate to mention that "no distinguishable rotation scheme" is not an evaluative category. It only indicates that the conditions of the four aforementioned categories (BC, BCr, U, Ur) are not fulfilled during the analysis of the corresponding elements of the given gymnasts.

That means that a gymnast, who turns according to a rotational scheme but has up to 20% of the turning elements in the opposite to the expected direction, is assigned to the corresponding category preceded by the weakening *restricted,* while another gymnast doing so but with more than 20% of unexpected elements passes to the category *no distinguishable rotation scheme*. Even if this limit is based on our experience while analyzing a large number of gymnasts the definition is arbitrary and serves exclusively for differentiation.

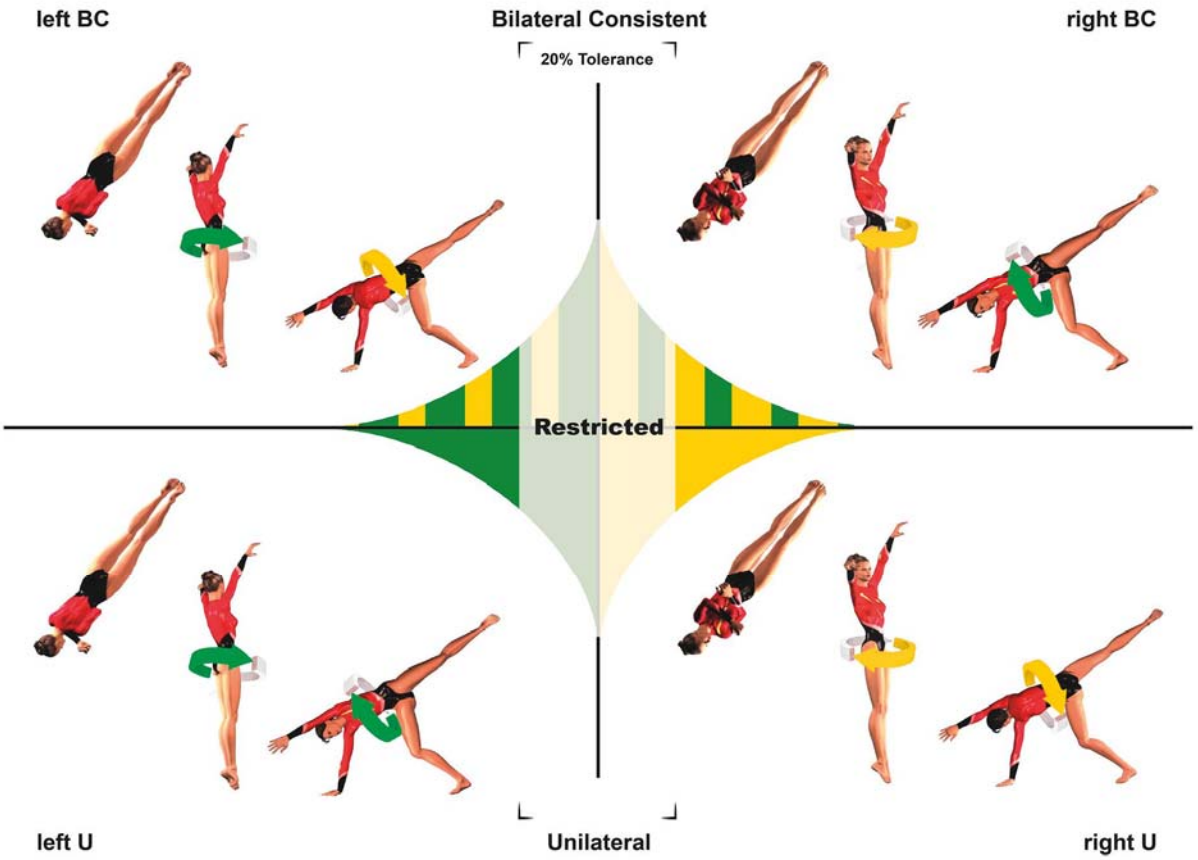

Figure 4. Classification matrix of turning schemes.

RESULTS

After having analyzed all elements, we decided to discard the dance and gymnastic elements since the consideration of them led to a result where no gymnast presented a distinguishable rotation scheme. At the end, only acrobatic elements were taken into account. With this change, all gymnasts of our sample were classifiable.

In former studies it was determined that the majority of the gymnasts exhibit a leftward turning preference. Until now the results were only obtained on the basis of the analysis of male gymnasts. We could not verify this with our selected sample of female gymnasts. The results revealed that 52% of them turn to the right while 48% prefer to rotate to the left after having crossed out the dance and gymnastic elements.

18 of all finalists have a pure bilateral consistent turning scheme (78%). Thus this seems to be the "normal" scheme of rotation. Ten gymnasts turn to the right and eight to the left. Only four gymnasts have a restricted turning scheme (two turn to the right and two to the left). Particularly striking is the category of unilateral rotation scheme, which was opened by the first placed Simone Biles (see Figure 5). So far no world class (male) gymnasts belong to this category. No lUr, rU or rUr gymnasts were among the finalists.

The rotational scheme seems not to influence the performance to determine who takes the medals. The distribution of the detected schemes is quiet even (see Table 3).

Table 3
Results of the Women's Individual All-Around Final at the Olympic Games in Rio 2016 and their rotational schemes.

Place	Gymnast	Country	Rotational Type
1	BILES Simone	USA	lU
2	RAISMAN Alexandra	USA	rBCr
3	MUSTAFINA Aliya	RUS	lBC
4	SHANG Chunsong	CHN	lBCr
5	BLACK Elsabeth	CAN	lBC
6	WANG Yan	CHN	lBC
7	LOPEZ Arocha JB	VEN	rBC
8	TERAMOTO Asuka	JPN	lBC
9	THORSDOTTIR Eythora	NED	rBC
10	STEINGRUBER Giulia	SUI	rBC
11	ANDRADE Rebeca	BRA	rBC
12	FERLITO Carlotta	ITA	rBC
13	DOWNIE Elissa	GBR	lBC
14	MURAKAMI Mai	JPN	rBC
15	BREVET Marine	FRA	rBC
16	FERRARI Vanessa	ITA	lBCr
17	SEITZ Elisabeth	GER	lBC
18	ONYSHKO Isabela	CAN	rBCr
19	DERWAEL Nina	BEL	rBC
20	WEVERS Lieke	NED	rBC
21	VANHILLE Louise	FRA	lBC
22	TUTKHALIAN Seda	RUS	lBC
23	SCHEDER Sophie	GER	rBC

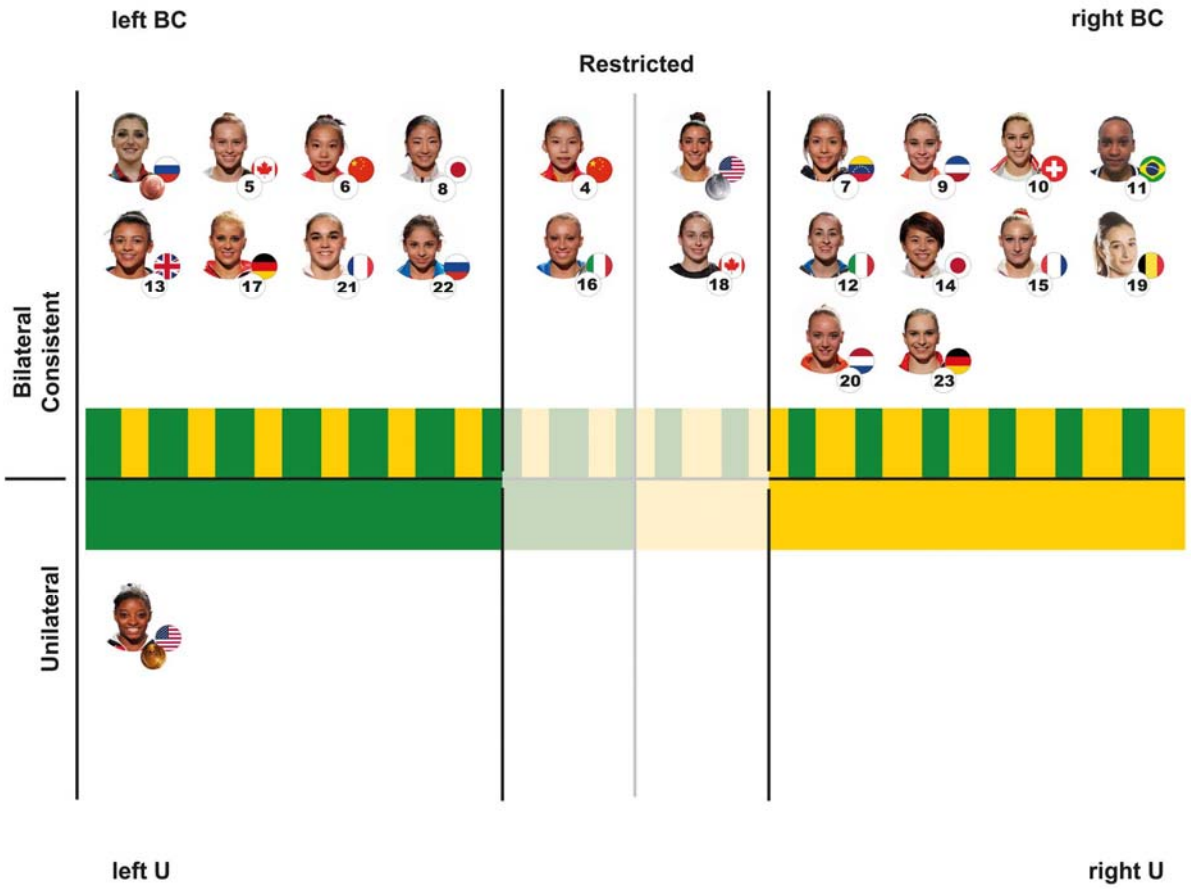

Figure 5. The gymnasts of the Women's Individual All-Around at the Olympic Games 2016 with their respective rankings sorted by their rotational scheme.

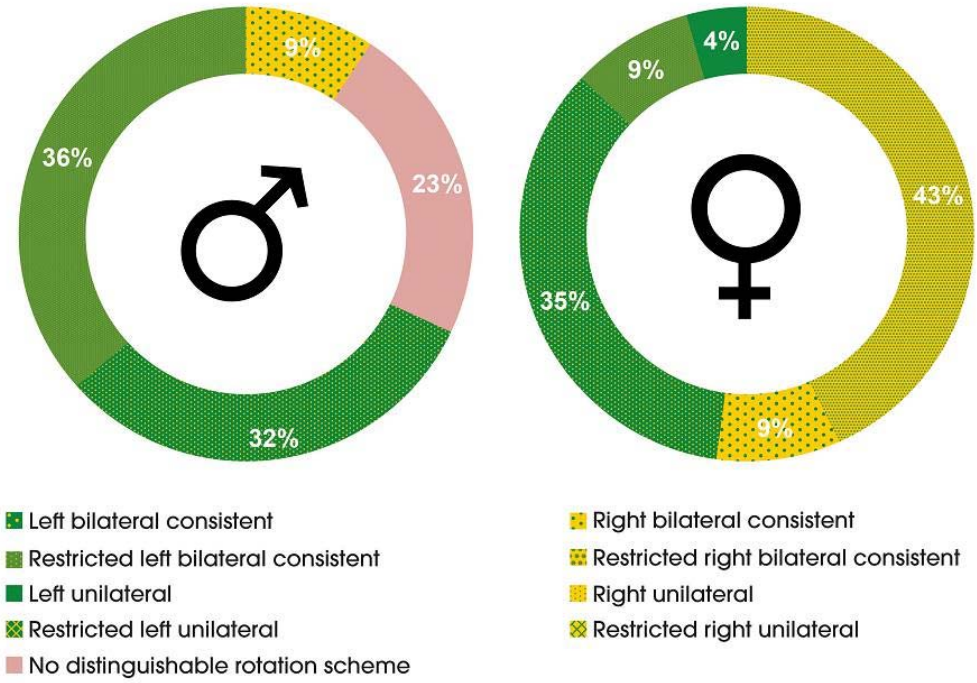

Figure 6. Comparison of the rotational schemes of the male and female gymnasts of the Individual All-Around Finals at the Olympic Games 2016 (only acrobatic elements).

There were nine countries that were able to qualify two gymnasts to the final (USA, RUS, CHN, CAN, JAP, NED, ITA, FRA, and GER)[1]. Only two nations (RUS and NED) seem to have a preferred rotational scheme. Both Russian gymnasts are lBC while the two Dutch gymnasts are rBC. With the current data and without having interviewed the national responsible person we cannot say if this finding is casual or a desired development in the sense of a national strategy. It would be interesting to know, whether the scheme was explicitly targeted or not to see if there is a national strategy inducing this result.

DISCUSSION

The current classification system can be used both for female and male gymnasts. However, until now the classification is only able to consider acrobatic elements. For a better understanding of the relationship between the elements with rotation around the longitudinal axis more data is needed. Above all, the relationship between dance, gym, and acrobatic elements is not yet clear and require further analysis. Therefore, we consider that the rotation scheme of world-class gymnasts should be further analyzed and recorded in a comprehensive database. It should be thought about the possibility to take into account further aspects like earedness and eyedness to determine which is the "right" turn direction.

The distribution of left and right turning female gymnasts was surprising at first. However, we believe that this distribution could be explained by the fact that female gymnasts experience a continuous ballet training which traditional contains turns to the right (Golomer, Rosey, Dizac, Mertz, & Fagard, 2009).

Female gymnasts seem to have a more systematic instruction than their male counterparts. This is only speculation. We do not have any evidence or reference sustaining this assumption. Despite that, we still believe that there is a big potential for improvement if the turning elements are taught more systematically. Additional review of the last codes of points reveals that the amount of turn elements is steady increasing in the last decades. The difficulty is decisively influenced by the numbers of turns. Therefore, we consider that the treatment of laterality issues must be forced in coaches‘ education. We are aware that a performance-facilitating rotational scheme is not necessarily needed when the level to be achieved is not very high. For instance, it is not a big problem for a performer in a context of Gymnastics for All to rotate the forward twist to the right and the backward twist to the left if they are the highest level skills that he will ever perform. This kind of lack of consistency occurs typically at a low level because neither the gymnast nor his coach perceives that the chosen direction for the forward twist corresponds to the direction of the round-off, which is indeed the opposite direction as explained above. However, at the least when the goal is to achieve excellence, coaches have to be sensitized to the fact that a logical rotation scheme is a crucial aspect that should be given attention from the beginning. Given that human beings decide at a very young age which is the preferred side to rotate, coaches have to pay attention and to influence the development of the skills actively. The gymnast performing twists forward and backward in different directions may have big troubles when trying to learn complex skills such as a Kasamatsu on floor, especially when using the technique half-in, half-out because in this case, the gymnast will twist during both a backward and a forward salto.

In this study, we replaced the absolute number of two non-matching elements through a percentage of 20 of all performed turning elements. In this context, it could be better to consider elements with the same number in the code of points only once. Otherwise, the possibility to disregard the scheme grows disproportionately (for

[1] Brazil qualified also two gymnasts, but one could not be analyzed because she could not finish the competition.

instance considering 3-4 round-offs in a routine).

A last aspect that has to be considered in the context of lateralization in further research, is the associated physiologically trained asymmetry. Bučar Pajek, Hedbávný, Kalichová, and Čuk (2016) found out that gymnasts do not have a balanced use of both legs during their balance beam routines, but a predominant use of the right leg. According to Niu, Wang, He, Fan, and Zhao (2011) a specific rotational training may lead to an increasing injury risk if no measures are planned in training to counteract the asymmetry.

CONCLUSIONS

Finally, we want to give some recommendations for the daily training.

- Recognize very early the natural direction of rotation of the athletes. This may be already set when you take charge of them. To identify this, exercises such as the following can be used:
  - Straight jump with ½ turn
  - Reaction tasks (the best is a competition), which also contain the need of rotation (i.e., standing, sitting or lying on the floor run to the coach when he claps his hands and tap him.
- Do not try to alter the natural direction of rotation.
- Teach the subsequent or following skills in concordance with the rotational scheme you consider the best. In our opinion you should teach BC schemes, left or right depending on the natural predisposition. The most important indicator to identify the appropriated turn direction is the support leg by swinging to handstand or performing a round-off. If a gymnast uses the left leg as the support leg during the round-off (as shown in Figure 2), he should turn to the left and vice-versa in order to be a bilateral consistent turning gymnast.
- In some cases, if the rotational scheme is not correct and the gymnast is still young consider changing the movements which do not fit into the scheme.
- If in some cases, you ignore the chosen scheme of rotation, be aware why you are doing so.

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APPARATUS DIFFICULTY IN RHYTHMIC GYMNASTICS ROUTINES – COMPARISON BETWEEN 2 OLYMPIC CYCLES

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Original article

Abstract

The aim of this study was to analyze the evolution of the apparatus difficulty in Rhythmic Gymnastics gymnasts in 2 Olympic cycles and identify eventual factors that could contribute to improve the performance quality in competition. We studied the value of the apparatus difficulty in the gymnasts (potentially the gymnasts could participate in the Olympic Games) of the first World Championships of each cycle (2012/2016 e 2016/2020). This analysis focused on the technical value of the apparatus difficulty performed by the gymnasts in a total of 288 competition routines in the World Championships 2013, and 200 competition routines in the World Championships 2017. The data was treated using the descriptive statistics and after checking the normality of the data distribution using the Kolmogorov-Smirnov test we used a t-test to determine whether there were significant differences between the World Championships. Results showed an increasing appreciation of the apparatus difficulty in the final score of the gymnasts. The apparatus difficulty elements were significantly increased from one cycle to the other, mainly due to the increase of the Mastery value. There's a greater balance in the use of different elements, giving privilege to the apparatus technique. The increase on the value of the apparatus difficulty in the RG competition routines will contribute for the quality and diversity of the RG competition in the Olympic Games.

Key words: *Rhythmic Gymnastics, Apparatus difficulty, Evaluation, Competition performance.*

INTRODUCTION

The Olympic competition is, for all participants the highest level of excellence in each sport. It is also the turning point for the new Olympic Cycle. In the beginning of each Olympic Cycle the International Gymnastics Federation (FIG) rhythmic Gymnastics Technical Committee presents the updates to the code of points in order to promote sports evolution, (Čuk, Fink, & Leskošek, 2012), through the increase of the complexity of the body and apparatus skills. In the present Olympic cycle, the most part of the changes in the Code of Points (CoP) were focused in the evaluation of the difficulty. The changes were related not only with the organization of the evaluation panel but also with the evaluation criteria. These changes and different implications in the way the routines are composed and of course in the training process. The skilful interaction between the gymnast and the apparatus and the increase difficulty

elements in the routines composition are the development in rhythmic gymnastics (RG), (Lebre, 2011).

Nowadays, the evaluation of individual routines of rhythmic gymnastics considers two main components, Difficulty and Execution. To evaluate these two components, as stated in the COP, the panel of judges must be formed by 10 judges, where 4 evaluate the Difficulty component and 6 evaluate the Execution component. In each of these judge groups there's a subdivision of tasks. In the evaluation of Difficulty (D), the judges D1 and D2 evaluate the number and value of the Body difficulties (BD), dance steps (s) and number of fundamental apparatus elements) and the judges D3 and D4 evaluate the number and value of the Dynamic Elements with Rotation (DER) and apparatus difficulties (AD). In the evaluation of Execution (E), the judges E1 and E2 evaluate the artistic component (Unity of composition, Music and Movement, Body expression and variety), and the judges E3, E4, E5 and E6 evaluate the technical faults (all technical deviations from correct performance), (FIG,2016). This structure of evaluation, with significant changes to the structure that guided the evaluation of competition in the previous Olympic cycle (2012/2016), leads to the necessity of reflect on and analyse the effects of its application.

In order to evaluate the magnitude of these changes, which happen in the beginning of each olympic cycle, is important to quantify them in the first World Championship of the Cycle.

Doing this evaluation in the first main competition of the cycle, we can use data in real time to allow coaches to adapt their training process to the last World Championship of the cycle where takes place the qualification process to the following Olympic Games.

Therefore, the aim of this study was to evaluate the differences registered in the first RG World Championship of 2 Olympic cycles, World Championships, Kiev 2013 (2013WCh) and World Championships, Pesaro 2017 (2017WCh). We focused our attention in the analysis of the changes in the Apparatus Difficulty due to the great amount of changes registered in the 2016 FIG CoP (FIG, 2016).

METHODS

Subjects and design

A total of 288 competition routines in the World Championships 2013, and 200 competition routines in the World Championships 2017, were analysed according to the concerned Code of Point rules (FIG, 2012; FIG, 2017).

All routines were analysed in video by three international RG judges. The RG judges observed each routine once and at the same time. The intraclass correlation coefficient (ICC) in test-retest method (intra-examiner) was 0.99. The ICC between the observers (inter-examiner) was 0.98.

Statistical Analysis

For the statistical analysis we used the Statistical Package for the Social Sciences - Version 17.0 (SPSS 17.0, Chicago, USA) and Microsoft Office Excel 2007. Descriptive statistics were calculated using the mean values as a measure of central tendency, standard deviation (sd) as a measure of dispersion, and minimum and maximum as measures of data range. After checking the normality of the data distribution using the Kolmogorov-Smirnov test we used a t-test to determine whether there were significant differences between 2013WCh (n=288) and 2017WCh (n=200) ranking. The routines were also analysed by apparatus Hoop, Ball, Clubs and Ribbon, to determine whether there were significant differences between 2013WCh (n=72) and 2017WCh (n=50) in each apparatus. A α level less than 0.05 was used as a criterion for significance.

RESULTS

We compare routines difficulty value of the 2 competitions (2013WCh and 2017WCh). In the table 1, we summarize the results all routines (global) and by apparatus, for the total difficulty value and

for the body and apparatus difficulty separately.

Table 1
Body, Apparatus and Total difficulty value of the routines presented in the RG World Championships 2013 and 2017.

	Hoop		**Ball**		**Ribbon**		**Clubs**		**Global**	
VALUE	WCh 2013 n=72	WCh 2017 n=50	WCh 2013 n=72	WCh 2017 n=50	WCh 2013 n=72	WCh 2017 n=50	WCh 2013 n=72	WCh 2017 n=50	WCh 2013 n=72	WCh 2017 n=50
Body Difficulty	4,59	3,13	4,67	3,24	4,89	3,33	4,94	3,41	4,7725	3,2775
Apparatus Difficulty	1,85	2,95	1,89	2,91	1,56	2,82	1,36	2	1,665	2,67
Total Difficulty	6,44	6,08	6,56	6,15	6,45	6,15	6,3	5,41	6,4375	5,9475

There are considerable differences between the results found in the 2 World Championships. Is visible an inversion on the importance each component of the total difficulty value. The Apparatus Difficulty values show more importance to achieve the final score in the 2017WCh than in the 2013WCh. For all apparatus we remarked a decrease in the Body Difficulty value and an increase of Apparatus Difficulty value. When we consider the values globally for all apparatus, we found statistically significant differences between these results, visible in the Figure 1.

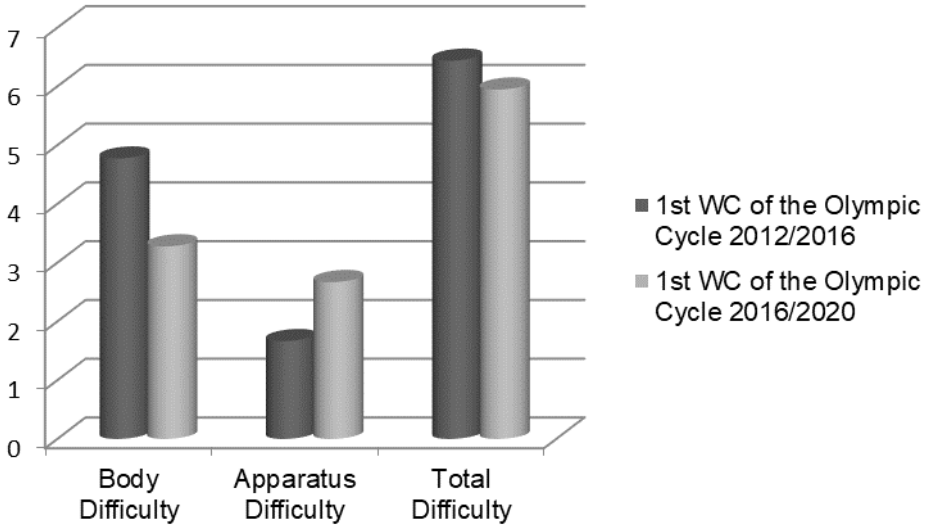

Figure 1. Comparison between the Body, Apparatus and Total difficulty values of the routines presented in the RG World Championships 2013 and 2017. (*p<0.05).

We analysed the difficulty value of the 2 components of the Apparatus Difficulty (Mastery/AD and DER) in all routines (global) and by apparatus (Hoop, Ball, Clubs and Ribbon) performed in both World Championships (Table 2).

Table 2
Apparatus difficulty components value, of the routines presented in the RG World Championships 2013 and 2017.

	Hoop		Ball		Ribbon		Clubs		Global	
VALUE	WCh 2013 n=72	WCh 2017 n=50	WCh 2013 n=72	WCh 2017 n=50	WCh 2013 n=72	WCh 2017 n=50	WCh 2013 n=72	WCh 2017 n=50	WCh 2013 n=72	WCh 2017 n=50
Mastery/AD	0,39	1,23	0,6	1,66	0,23	1,2	0,24	0,82	0,37	1,23
DER	1,46	1,72	1,29	1,25	1,33	1,62	1,12	1,18	1,3	1,4425

As we can see in Table 2, is clear a high increase of the Mastery/AD value from the 2013WCh to the 2017WCh. Statistically significant differences between the value of Mastery/AD registered in both World Championships were found (Figure 2).

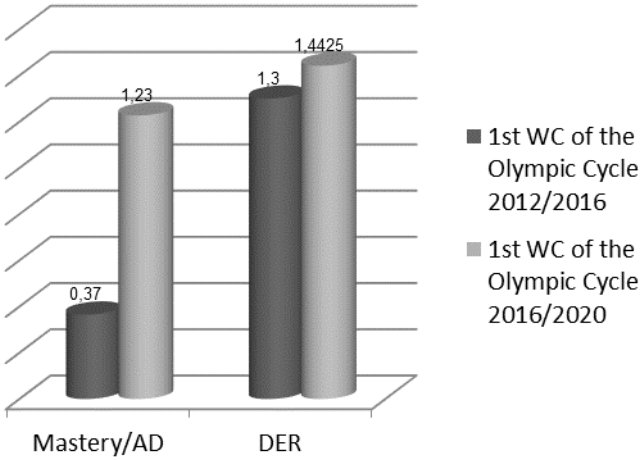

Figure 2. Comparison between the Mastery/AD and DER values of the routines presented in the RG World Championships 2013 and 2017. (*p<0.05).

In the Figure 3 it can be observed the contribution (in percentage) of the body and Apparatus Difficulty (Mastery/AD + DER) for the total difficulty value in the 2013WCh and the 2017WCh.

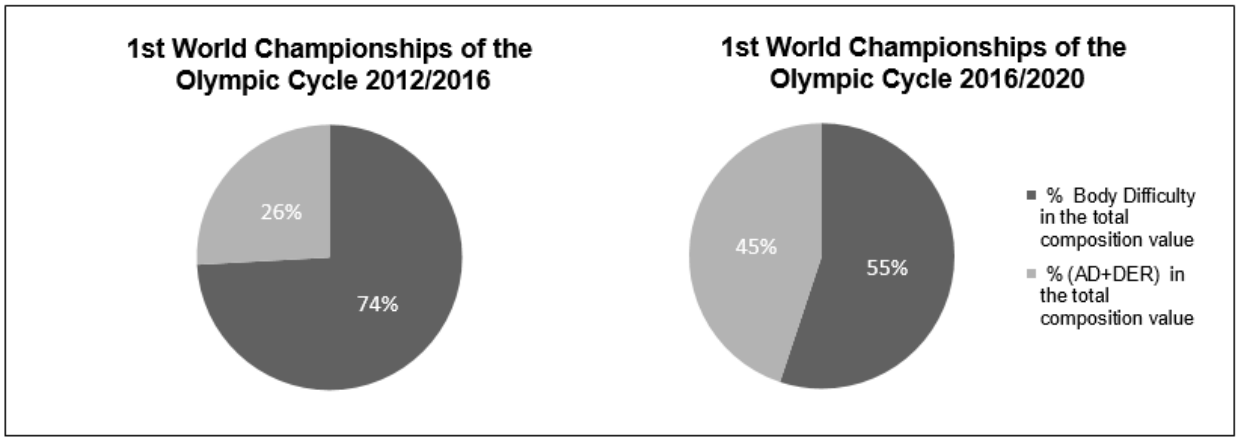

Figure 3. Percentage of Body and Apparatus difficulties value, of the routines presented in the RG World Championships 2013 and 2017.

We can see that the contribution of the 2 components for the total difficulty value are clearly more balanced in the present Olympic cycle (45% - 55% in the present cycle against 26% - 74% in the past cycle).

The possibilities of usage for the apparatus (mastery or DER) are shown on Figure 4.

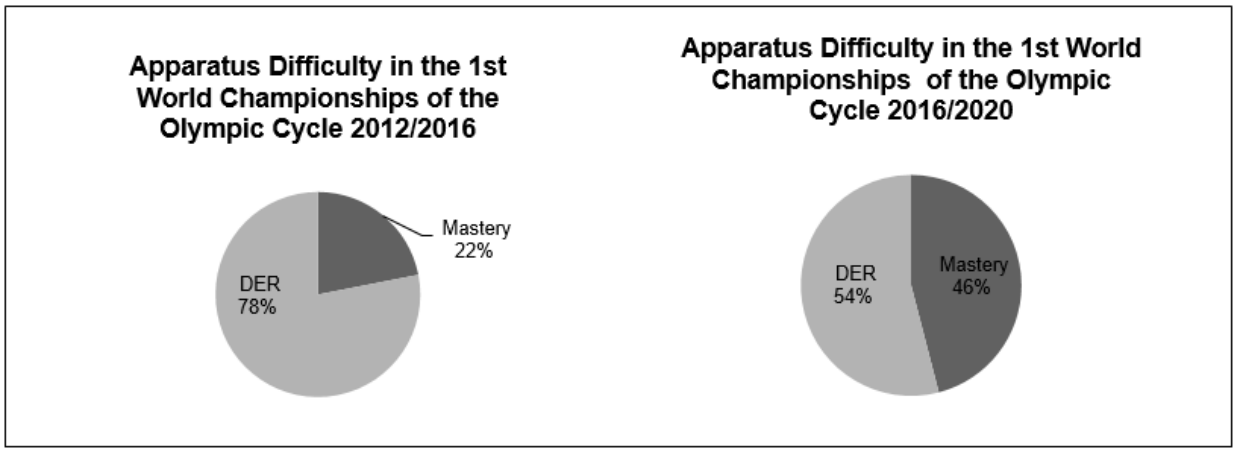

Figure 4. Percentage of apparatus difficulty components value, of the routines presented in the RG World Championships 2013 and 2017.

Analysing the Apparatus Difficulty, we could see that the Mastery/AD registered a visible increase from the 2013WCh to 2017WCh. The distribution of Apparatus Difficulty components is much more balanced in the 2017WCh (54% DER and 46% Mastery/AD) than in the 2013WCh (78% DER and 22% Mastery/AD).

DISCUSSION

After analysing at the results, we remarked big differences between the data of the 2 World Championships either when consider for all routines (global) either by apparatus (Hoop, Ball, Clubs and Ribbons). The main change in the data from one Olympic Cycle to the other was register in the Apparatus Difficulty component. These differences was statistically significant.

Rhythmic Gymnastics has been experiencing a constant and outstanding technical evolution for the last decades because of the evolution of the Code of Points (Palomero, 1996; Liu & Kuang, 2001; Wang et al, 2013), meaning these results could be seen in two different ways.

In one hand the intention to improve/reinforce/develop the specifics of Rhythmic Gymnastics, which is characterized by the manipulation of handling apparatus (Bobo & Sierra, 2003), and, in the other hand, considering the great complexity of execution (Vitrichenko et al, 2011) which needs a great number of work hours (Lebre, 2011). We can also speculate that the final grade will allow a better identification of the gymnasts' position in the ranking (Leandro et al, 2017), given the fact that the gymnasts with lower ranking face greater difficulties to get better grades (in Masteries/ AD and DER), due to execution problems (Breitkreutz & Hökelmann, 2014).

The execution of the Apparatus Difficulties demands extraordinary coordination, (Sierra & Bobo, 2015). However, they are also those where the gymnasts can have more technical faults which cancel the value of the difficulty, especially in the weaker gymnasts (Leandro et al, 2016). The gymnasts with the intention of getting top scores should present routines with a high level of difficulty combined with good execution quality (Agopyan, 2014).

So, according to the bibliography available, we might be in the presence of an increase to the degree of execution complexity caused by the improvement of

the apparatus technique and also a possible technical restructuration of Rhythmic Gymnastics.

Besides these factors, is also relevant to know whether the factors related to the sport specificity as the structure/organization of the Code of Points, the evaluation criteria defined by the sports authorities has an influence (positive or/and negative) on the gymnasts final scores (Leandro et al, 2015).

We also analysed the value of each component of the technical work of apparatus, (Mastery/AD and DER) and remarked that there was a clear increase of the Mastery/AD value from the 2013WCh to the 2017WCh, with significant differences. These differences can be related to the updated CoP 2017 (FIG, 2017), that redefined the evaluation criteria and increased the value of these technical elements. Other cause for the results registered can also be related to the fact that the training and competition process is always searching for better results by the inclusion of more complex abilities (Massida, 2012; Leskošek, Čuk, & Bučar-Pajek, 2015).

When we analyse the contribution, in percentage, of the body and apparatus difficulty for the total difficulty value in the 2013WCh and the 2017WCh, we can see that, for the total difficulty value, the contribution is clearly more balanced between 2 components in the present Olympic cycle. This balance works mainly due to the increase of the Mastery/AD elements. According to (Bobo & Sierra, 2003), it is very important to allow a balanced appreciation of the different dimensions of the sport, in both aspects of quality or quantity in the performance of gymnasts.

Additional research in other competitions of the present cycle to confirm the consistency of the results, being even usual for the technical committee to readjust the COP after the 1st WCh of each cycle.

In conclusion, the results found with this study can help to understand the real effect in competition routines caused by the changes in the CoP. It can also help coaches to find strategies to improve the training process and foresee the path that follows the evolution of the sport, with more diverse and varied choreographies and compositions, given the fact that there's a greater balance in the use of different elements, giving privilege to the apparatus technique. Finally, the results we got show the possibility of a sports show with more intensity, variety and balance for the next Olympics Games in Tokyo 2020.

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THE IMPACT OF THE CHANGE IN THE MUSICAL ATTRIBUTES OF THE CODE OF POINTS (2013-2016) ON THE ROUTINES IN RHYTHMIC GYMNASTICS OF THE RIO 2016 OLYMPIC GAMES

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Original article

Abstract

The Rhythmic Gymnastics Code of Points, 2013-2016, was a milestone by allowing vocal music in routines. This study aimed to analyze the impact of this change in the routines, at the RIO 2016 Olympic Games. This is a documentary research, with two types of sources: official International Federation of Gymnastics; and videos of the routines. The sample was composed of 26 individual athletes and 14 teams. The analysis was quantitative (incidence parameter) and qualitative (type of music). As a result, we identified that, of the 104 songs of individual routines, 81 were instrumental music (IM) and 23 represented music with voice and words (MVW). Among the IM, 21 were North-American (NA) and 60 from other nationalities (ON). Of the MVW, 11 were NA and 12, from ON. In team routines, of the 28 songs, 17 were IM and 11 were MVW. Of the IM, 6 were NA and 11, from ON. Among the MVW, 6 were NA and 5, from ON. We conclude that most of the gymnasts and teams used this new rule of the Code of Points. This change was effectively incorporated into world prominence delegations, and we verified the strong influence of NA music.

Key words: *Rhythmic Gymnastics, Olympic Games, Code of Points, North-American Music.*

INTRODUCTION

Since its regulation as a sport by the FIG in 1970, Rhythmic Gymnastics (RG) "has a set of rules that guide evaluation techniques of gymnasts and, therefore, training methods and composition of choreography" (Toledo & Antualpa, 2016). These choreographies, also called routines or series, assume an artistic character of this discipline, an affirmation supported by various authors and former renowned gymnasts, considering those from the last decades (Heins, 1978; Bodo-Schmid, 1985; Robeva & Rankélova, 1991; Lisitskaya, 1995; Bobo & Sierra, 1998) and more contemporary ones, as will be demonstrated below. The FIG itself, the regulatory entity of this practice, highlights this character in the definition:

»Combining the elegance of the ballet with the drama of the theatre, Rhythmic

Gymnastics bursts with glamour, *blurring the boundaries between sport and art*. Rhythmic gymnasts strive to enchant judges and audiences with the polish of their exercises while executing enormously difficult maneuvers with one of four handheld apparatus: the Hoop, Ball, pair of Clubs and Ribbon (FIG, 2018)«.

With its origin in the discipline's own history, this relation was influenced by artists and pedagogues, specifically those from the areas of theater, music and dance, within which a few names deserve to be highlighted: Jean Georges Noverre, François Delsarte, Rudolf Von Laban, Isadora Duncan, Elizabeth Duncan and Emile Jacques Dalcroze (Langlade & Langlade, 1970; FIG, 2018).

Music, and therefore its interpretation by the gymnast, is a very important element in routines of RG (FIG, 2013), in which strict harmony between the music's character and rhythm, and the character of the exercise and its movements is a necessity (FIG, 2001). Through it and the body language of the gymnasts combined, athletes convey to the public a few prints, as the choreography allows the subject to express their thoughts and feelings on a theme (Sborquia, 2008). Music is so important in the routines of RG that modifications related to it in the Code of Points (CoP), which occur every four years at the end of each Olympic cycle, bring significant changes to the discipline. For practically the same group of authors, the artistic dimension is part of the study of the content of the routines:

The study of the routines content should cover not only the technical elements: body, apparatus, and group specificities, but also, as the execution artistic dimension since it is from the combination of all these factors that is possible to point out a comprehensive and integrated analysis of the RG routines composition. (Ávila- Carvalho, Leandro & Lebre, 2014, p.90).

The CoP "provides universal guidelines established by scientific and technical committees to assess the performance and promotion of sports development" (Ávila-Carvalho, Klentrou & Lebre, 2012), and the changes ensure a better precision in the judgment of gymnasts and improve the quality of this sport (Leandro, 2016). However, the constant changes made to the CoP may, at times, prejudice the gymnasts' training and routines, as well as plans established for the training of techniques (foreseen within an Olympic cycle - the macrocycle), specially when these changes are made within a single cycle of the CoP, through the "FIG newsletters".

Lourenço (2010, p.116;140) provides us with an interesting view regarding these aspects:

[…] RG still has a big problem to be solved, which is the question related to the duration of the rules. The Code is organized, at first, to last four years, but changes take place annually, with the systematic production of "FIG newsletters" that present clarifications, but also, many changes in criteria and minor adjustments in the rules that hinder the understanding of referees and a lighter assessment. The "FIG newsletters" also bring the originality of the year and new difficulties created and already granted by the FIG Technical Committee. We realize that gymnasts and especially coaches are concerned with always staying alert to changes, in order to enhance their compositions without running the risk of unnecessary prejudice. [...]. The RG Code of Points mutates, new changes should occur in the space of, at least, four years, but they happen annually. Although people notice these changes, especially in difficulty and the *artistic* component, and seek an adequate manner to work with them [...] they still do not have an exact idea of the totality and maybe do not notice the possibilities that these changes offer in helping with the identity of their work (our emphasis).

Still speaking about the musical aspect, evaluated by the "artistic", up until 2012, the CoP allowed the vocal accompaniment in songs if the human voice was used only as an instrument (no

words). In the following CoP (2013-2016), music is allowed to be interpreted by one or more instruments or a musician, including the voice used as an instrument, but only in one of the four individual routines, and in one of the two group routines.

1.5.5 The music can be interpreted by one or several instruments, *including the voice used as an instrument.* All instruments are authorized provided that they express music with the characteristics necessary to accompany an RG exercise: clear and well- defined in its structure.

1.5.6 Musical accompaniment of voice with words may be used for one Group exercise and two individual exercises *in respect to ethics*. (FIG, 2013 - our emphasis).

According to Toledo and Antualpa (2016, p.129), this permissiveness of routines with music with voice and words (MVW) and significant changes in the assessment of the artistic aspects of the routines of this code marked this edition of the CoP for a few reasons:

The promoting of the artistic aspects of RG in the new CoP meets the origins of the sport. Such condition shows the manifestations of rhythmic and dance, as major influences of the artistic character of this sport. An aspect that has been valued in the teaching of the sport, by some authors in contemporary times, such as Toledo, Vidal, Marquez and others. The current Code of Points (2013-2016) can be regarded as a cycle, which marks the sport's story by two aspects: the permissiveness of routines with singing (which, since the creation the CoP, has not been allowed) and significant changes in the appreciation of the artistic aspects of the routines.

In regard to the music characteristics, Junior (2006, p.37) defines the "musical performance as an act of communication that assumes a relationship between performer and listener," citing performative aspects, such as rhythm, musical performance, bodily and vocal settings, in addition to aspects of musical composition, such as loudness, reverb, and pitch of the voice in relation to musical instruments. A few of these aspects are requirements in the Rhythmic Gymnastics routines, either directly or indirectly, and contribute to what the FIG defines as "Artistic Components" (FIG 2013).

Before this undeniable influence of music in the sport, this study aims to identify and analyze the impact of the change in the CoP (2013-2016) in permitting music with voice in the "Artistic Components", in one of the routines (both individual and team), in the first version of the Olympic Games (OG) that succeeded it, by identifying them in the finalists' routines, at the RIO 2016 Olympic Games.

Thus, this research brings accurate and important data on the world cenario, about the use or not of this recent change of CoP, by the most international teams. The manuscritp has an unprecedented way of presenting and re-organizing the date (already made available by official FIG documents), as well as by analyzing them in the scientific field (with a quantitative and qualitative approach).

METHODS

This research is descriptive and documentary (Gerhardt & Silveira, 2009), since it seeks to describe facts and phenomena of a reality from the analysis of sources. For the researcher Craig Kridel, from the University of South Carolina (USA), in an article published by the American Educational Research Association (AERA, 2017), documentary research, serving as both a complement to and extension of biographical inquiry, takes on different meanings in the field of education. In one sense, documentary research becomes synonymous with archival research and addresses issues related to the role and use of documents and public and private records. In another sense, documentary research produces artifacts and material culture through

artistic representation, moving and still imagery, and sound recordings.

For this study, we used two main documentary sources. The first refers to the files titled “Individual / Group Music Selections” (official FIG document), available in the federation's institutional website, in reference to the RIO2016 Olympic Games. It contains a list with the names of the athletes/teams and the names of the songs of the routines and their respective interpreters/composers. The second documentary source was composed of video images available on an online platform (www.youtube.com), which were searched for using a combination of keywords: “Name of the athlete + apparatus + Rio 2016” (individual routines) or “country name + apparatus + RIO2016” (group routines). The search was conducted from April to May 2017, based on the data obtained in official FIG documents.

The sample included the finalist athletes and teams of Rhythmic Gymnastics participating in the RIO 2016 Olympic Games, and was composed of 26 individual athletes and 14 teams. We considered the series of the four apparatuses previously defined by FIG for this event: ball, hoop, clubs, and ribbon. In addition, the two apparatuses combined were also considered: five ribbons and three pairs of clubs + two hoops, established for this cycle in the group category.

In a first analysis of the date, although it was not our primary aim, caught our attention the use of North American Music. Due to the primary purpose of the study and the spatial limitations of this manuscript, we chose to bring this unique and highlight characteristic in the date, as categories of the study. Next manuscripts will bring the analysis of the other typologies of the used songs (other nationalities and styles like - folk, popular, classic etc).

The data were organized into a worksheet and, subsequently, into two different tables: one for individual series and another for group series (Charts 1 and 2). Once we began analyzing the typology of the songs, they were analyzed and classified into two distinct categories, distributed into two tables, with 4 categories: Music with voice and Words (MVW - identified with a "shadow" in its name) or Instrumental Music (IM); North American Music (NAM) or Music from Other Nationality (MON). We chose to highlight one or two options in each table in order to allow for better visualization of the charts and analysis of the data.

Following the classification of the music in one of the two aforementioned categories, we began the data analysis. First, a quantitative analysis was performed by means of descriptive statistics, which, according to Morais (2005), is used to summarize the data collected from an investigation and to arrange them in numbers, tables, graphs, etc.

Next, we analysed the number of songs that represented IM and MVW that the athletes/teams used during the competition, and in which apparatus they were used. As has already been mentioned, due to the emphasis given to North American music, we chose to also identify how many of these songs were used during each phase of the competition, in an attempt to establish the influence of this music in the Rhythmic Gymnastics competition, focus of this study.

RESULTS

The results will be presented following the proposed objectives, by identifying, separately, the incidence of IM and MVW first in the individual routines and then in the group routines.

Individual Routines

In individual routines, represented by 26 gymnasts from 24 countries, we identified the following data from the documents utilized (“Individual Music Selections” and videos). The following table was elaborated from information contained in the FIG document (open acces) after verification against the videos, presenting the name of the gymnasts (in

alphabetical order of the countries they represented), and the respective songs used in the routines (title and interpreter/composer), for each apparatus.

Table 1
Individual Music Selections in routines of the RIO2016 Olympic Games

INDIVIDUAL ROUTINES

	Gymnasts	**Apparatus**			
		Hoop	**Ball**	**Ribbon**	**Clubs**
1.	**Danielle Prince (AUS)**	"Nostradamus" – Maksim Mrvica	"Prelude" – Brian McKnight	*"Americano"* - *Lady Gaga*	"Big Beat" – Touch and Go
2.	**Nicol Ruprecht (AUT)**	"Tango Jalousie" – Barcelona Symphony Orchestra	"Summer Time" – Smooth Ballroom Orchestra	*"Kiss"* - *Prince*	"Carmen Suite" – Vienna Symphony Orchestra
3.	**Marina Durunda (AZE)**	('Harbors', Piano version) – Rashid Afandiyev Nasiboghiu	"Madame Papillon" – Rene Aubry	"Never Enough (Caspian Mix) – Emin Agharalov	*"Hey Pachuco"* - *Majas Band, Kseniya Shamarina, Ivonna Freidmane*
4.	**Katsiarina Halkina (BLR)**	*"Ondeia"* - *Dulce Pontes*	"Carol of the Bells" – The Piano Guys	"Tchiki Tchiki Tchiki" – Little Barrier	"Once Upon Love" – William Joseph
5.	**Melitina Staniouta (BLR)**	"Agnus Dei" - Noella	"Fantasy for Violin and Orchestra" – Joshua Bell	"Gipsy Romance" – Folk Music Orchestra	"Appassionata" – Valentina Lisitsa
6.	**Nataliá Gaudio (BRA)**	"Smells like teen spirit" – David Garrett	*"Bandolins"* - *Oswaldo Montenegro*	"Cidade Maravilhosa" – Dudu Nobre e Diego Nicolau	"Dracula" – Wojiech-Kilar
7.	**Neviana Vladinova (BUL)**	"Theme from Schindler's List" – Itzhak Perlman	"Tanguera" – Sexteto Mayor	*"Buleria"* - *David Bisbar*	"Mixed – Ouverture, Nostalic, Extreme, Delirium" – Les Tambours du Bronx
8.	**Rong Shang (CHN)**	"Habanero" - Maksim	*"Addio Del Passato"* - *Fillippa Giordanno*	"Piano Fantasy" – William Joseph	"Apasionada" – Enzo Draghi
9.	**Elyane Boal (CPV)**	"Fanatico Master" – Edwin Marton	"Summertime" – Porgy and Bess	*"Christal Fighters"- Christal*	"Knock on Wood"

				Fighters	– Safri Duo
10	**Carolina Rodriguez (ESP)**	"Punta de faro (Nueva antologia) – Paco de Lucia	*"Imaginando" - Diana Navarro*	"Tema de Sira (El tiempo entre costuras) – Cesar de Benito	"Flamenco (Pulse)" – Eva Yerbabuena
11.	**Ekaterina Volkova (FIN)**	" Espana Cani" – Spanish Gypsy Dance (Paso Doble)	"Lonely Day" – System of a Down	"Summertime & Storm from Four Seasons« - Ikuko Kawai	*"Cuba 2012" – Dj* Rebel
12.	**Kseniya Moustafaeva (FRA)**	"Song on the Beach" – Arcade Fire	"In the middle somewhat elevated" – Thom Willems	*"Je vais t'aimer" - Michel Sardou*	"Escape from East Berlin" – Daniel Pemberton
13.	**Salome Pazhava (GEO)**	"Unstoppable" – E. S. Posthumus	"Chalkboard" – Ayeron	*"Supremacy" – Muse*	"Rachuli (Mokle Kaba)" – Group Bani
14.	**Jana Berezko-Margrander (GER)**	*"A little party never killed nobody" – Fergie*	"Maxime Rodriguez" – Maxime Rodriguez	"Como Se Anda en El Campo" – Korge Padro, Manolito Soler, Manolo Carrasco	"Olei" – Nino Katamasze & Insight
15.	**Varvara Filiou (GRE)**	"Someone Else" – Allegro Feat. L.V., Fresh Game & Cokni O'Dire	"The death of the bull" – Stavros Lantsias	*"Got you" (I feel good) - James Brown*	"Zorbas Dance – Sirtaki" – Mikis Theodorakis
16.	**Neta Rivkin (ISR)**	"Eleanor Rigby" – The Beatkes	"Just for You" – Giovanni Marradi	*"Grande Amore" - Il Vivo*	"Paint in Black" – The London Symphony Orchestra
17.	**Veronica Bertolini (ITA)**	"Je suis malade" – Serge Lama	*"Que Viyera" - Cirque du Soleil*	"Hunger ("Black Hawk Down" Soundtrack) – Hanz Zimmer	"Romani Holiday (Antonius Remix)/Sherlock Holmes 'A game of Shadows" sountrack) – Hanz Zimmer
18.	**Kaho Minagawa (JPN)**	"All By Myself (Cover S. Rachmaninov)" – S. Rachmaninov – L. Dalton	"I Will Always Love You" – S. Rachmaninov – L. Dalton	"Waltz from ballet "Seven Beauties" – Royal Phillarmonic Orchestra	"Cabaret Sata" – Jean-François Cote
19.	**Sabina Ashirbayeva (KAZ)**	*"Tango" - DJ Valer*	"Sheherezada" – Nikolay Rimsky-	"Monster Bossa" – Murray Gold	"Latin Mix" – Alessandro Olivato

			Korsakov		
20.	**Yeon Jae Son (KOR)**	"Valse" – Nicolas Jorelle	*"Parla Piu Piano" - Filippa Giordano*	"Michel Camilo, Cinema Serenade, Orquesta del Tango" – Astor Piazzolla	"Oye Negra (part 1), Oye Negra (part 2)" – Terry Snyder, Edmundo Ros
21.	**Ana Luiza Filioranu (ROU)**	"Strenght of a thousand men" – Two Steps From Hell	"Run" – Ludovico Einauldi	"Magnifica Presence" – Orchestra directed by Catalano & Giuseppe Sasso	"Gimme Gimme Gimme" – The Royal Phillarmonic Orchestra
22.	**Yana Kudryatseva (RUS)**	*"Horse" - Male Choir Persevere*	"Piano Concerto in A major K 488 2 Adagio" – Amati Chamber Orchestra& Dalia Ouziel	44" – London Symphony Orchestra/G. Rozhdestvensky	"Black Gold" – Armand Amar & Orchestra
23.	**Margarita Mamun (RUS)**	"Conserto de Berlin" – Vladimir Cosme	"Morceaux de Fantasie Op. 3" – M. Maisky/S. Tiempo	"Black Swan – Night of terror" – C. Mansell & Orchestra	*"We will rock you"* – *Queen*
24.	**Ganna Rizatdinova (UKR)**	"Espana Cani" – Trio Norte	*"I put a spell on you" - Annie Lennox*	"Tomorrow Never Comes / Time to go crazy" – Rishi & Harshii	"They don't care about us" – Michael Jackson/David Garrett, Franck Van der Heijden & Royal
25.	**Laura Zeng (USA)**	"Moonlight Sonata – 3rd Movement" – Monsalve	*"Feeling Good" - Jennifer Hudson*	"Chez Les Ye Ye" - Boogalox	"Bolero" – Andre Rieu
26.	**Anastasiya Serdyukova (UZB)**	"Boat Chase" – John Powell	*"Sway" - Rosemary Clooney*	"Vokallz" – Brilliant Dadashova	"Ring ring ring" – Kurd & Rud

* *MVW - in italic*
Source: Adapted from FIG (2016)

Table 2
Use of North American Music (NAM) and Music from Other Nationality (MON) in RG individual routines of the RIO2016 Olympic Games.*

	Gymnasts	Apparatus			
		Hoop	Ball	Ribbon	Clubs
1.	Danielle Prince (AUS)	NAM	NAM	NAM	MON
2.	Nicol Ruprecht (AUT)	MON	NAM	NAM	MON
3.	Marina Durunda (AZE)	MON	MON	MON	NAM
4.	Katsiarina Halkina (BLR)	MON	NAM	MON	NAM
5.	Melitina Staniouta (BLR)	MON	MON	MON	MON
6.	Nataliá Gaudio (BRA)	NAM	MON	MON	MON
7.	Neviana Vladinova (BUL)	MON	MON	MON	MON
8.	Rong Shang (CHN)	MON	MON	NAM	MON
9.	Elyane Boal (CPV)	MON	MON	MON	MON
10	Carolina Rodriguez (ESP)	MON	MON	MON	MON
11.	Ekaterina Volkova (FIN)	MON	NAM	MON	MON
12.	Kseniya Moustafaeva (FRA)	NAM	NAM	MON	MON
13.	Salome Pazhava (GEO)	MON	MON	MON	MON
14.	Jana Berezko Margrander (GER)	NAM	MON	MON	MON
15.	Varvara Filiou (GRE)	NAM	MON	NAM	MON
16.	Neta Rivkin (ISR)	NAM	MON	MON	NAM
17.	Veronica Bertolini (ITA)	MON	MON	NAM	NAM
18.	Kaho Minagawa (JPN)	NAM	NAM	MON	MON
19.	Sabina Ashirbayeva (KAZ)	NAM	MON	MON	MON
20.	Yeon Jae Son (KOR)	MON	MON	MON	MON
21.	Ana Luiza Filioranu (ROU)	MON	NAM	MON	NAM
22.	Yana Kudryatseva (RUS)	MON	MON	MON	MON
23.	Margarita Mamun (RUS)	MON	MON	MON	MON
24.	Ganna Rizatdinova (UKR)	MON	MON	MON	NAM
25.	Laura Zeng (USA)	MON	NAM	MON	MON
26.	Anastasiya Serdyukova (UZB)	MON	NAM	MON	MON

* *NAM - in italic*

Group routines

In group routines, represented by 28 routines from 14 different countries (with two routines per country), we identified the following information from the documents used ("Group Music Selections" and videos), presented in the following table, elaborated within the same logic of the table 1: name of countries (in alphabetical order) and of songs of the respective routines (title and interpreter/composer).

Table 3
Use of Music with Voice and Words (MVW) in RG group routines of the RIO2016 Olympic Games.*

	GROUP ROUTINES		
	Country	**Apparatus**	
		5 Ribbons	**Hoops+Clubs**
1.	**Belarus**	"Malaguena" – Benise	"Toccata and Fugue" – Bach Player David Garrett
2.	**Brazil**	*"Aquarela do Brasil" – Ivete*	"Mas que nada / Tico tico no Fubá

		Sangalo e Otavio Santos	/Brasileirinho" – Otavio Santos
3.	**Bulgaria**	"Yuvigi Han" – Gergi Andreev and Sofia Phillarmony	"Matrix – Mix / Chateau, Monalisa Overdrive, Burly Brawl" – Rob Dougan, Juno Reactor, Don Davis
4.	**China**	*"Swan Lake" – Dark Moor*	"Batucada" – Dj Dero
5.	**Spain**	*"Vida Carnaval, Bahiana/Batucada, Samba School, Sambuka" – Carlinhos Brown, Inner Sense, Artem Uzunov*	"Cementerio Judio, La aurora de Nueva York, Solea" – R. Amargo, Eduardo Cortes, J. Parrilla, F. Rodrigues
6.	**Germany**	"Christ Trilogy" – Balzs Havasi & Dohnanyi Orchestra Budafok	*"We will rock you" – Queen & Dean Cohen*
7.	**Greece**	"Zorbas Ballet Suite" – Mikis Theodorakis	"I want you to know" – Manolis Chiolis, Mimis Plessas
8.	**Israel**	"Phantom of the Opera" – Lindsey Stirling	*"Jerusalem, Rak Rotza Lirkod" – Itay Kalderon ft. Gad Elbaz, Moshe Peretz & Omer Adam*
9.	**Italy**	"Tu si' na cosa grande / Tammurriata near / Nessun Dorma" – Massimo Ranieri / Damiano Mazzone	*"Dance de Phyrne (from 'Faust', act V, scene 1)" - Herbert Von Karajan and Philharmonia Orchestra*
10.	**Japan**	"Maria Magdalena, Sabor a MI, Amparame" – Rindo, Kenny G, Lucrecia	"Tough Lover, Party Rockers, Loving You" - Christina Aguilera, Judith Hill, Gordon Goodwin's big phat
11.	**Russia**	*"Samba do Brasil, those were the days" - Belini, Group Na-Na*	"The Holy Spring, Time Forward" – State Academic Symphony Orchestra of the USRR
12.	**Ukraine**	"Time to go crazy / Take you down" – Rishi & Harshii / Daniel Pemberton	*"Vogue" – Madonna*
13.	**United States**	Piano Concerto No 2 in G minor Op. 22 Presto" – Pascal Roge & Royal Symphony Orchestra	*"Tumba" - Angelique Kidjo*
14.	**Uzbekistan**	*"I will not die" - Ingrid Kup*	"A Visit from the Zoo, The end Begins" – Safri Duo, Gerard K. Marino

**MVW – in italic*
Source: Adapted from FIG (2016)

Table 4
Use of North American Music (NAM) and Music from Other Nationality (MON) in RG group routines of the RIO2016 Olympic Games.*

Country	**Apparatus**	
	5 Ribbons	Hoops+Clubs
1. Belarus	MON	*NAM*
2. Brazil	MON	MON
3. Bulgaria	MON	*NAM*
4. China	*NAM*	*NAM*

5.	Spain	MON	MON
6.	Germany	MON	MON
7.	Greece	MON	MON
8.	Israel	*NAM*	MON
9.	Italy	MON	MON
10.	Japan	MON	*NAM*
11.	Russia	MON	MON
12.	Ukraine	MON	*NAM*
13.	United States	*NAM*	*NAM*
14.	Uzbekistan	*NAM*	*NAM*

** NAM – in italic*

As the results were presented by routine type (single or group), the analyses will be presented in the same way.

Individual Routines

Table 5 – *Profile of the music (MVW and IM), by apparatus, of individual routines at the RIO2016 Olympic Games*

	Hoop	**Ball**	**Ribbon**	**Clubs**	**Total**	**%**
Music with voice and words	4	8	8	3	23	22,11
Instrumental Music	22	18	18	23	81	77,88

Table 6
Type of the music (NAM and MON), by apparatus, of individual routines at the RIO2016 Olympic Games.

	Hoop	**Ball**	**Ribbon**	**Clubs**	**TOTAL**	**%**
North-American Music	7	10	8	7	32	30,76
Music from Other Nationalities	19	16	18	19	72	69,23

Group Routines

Table 7
Profile of the songs (by apparatus) of all the finalist routines at the Rio 2016 Olympic Games.

	5 Ribbons	**Hoops+Clubs**	**Total**	**%**
Music with voice and words	5	6	11	39,28
Instrumental music	9	8	17	60,71

Table 8
Type of the music (NAM and MON), by apparatus, of group routines at the RIO2016 Olympic Games.

	5 Ribbons	Hoops+Clubs	TOTAL	%
North-American Music	4	8	12	42,85
Music from Other Nationalities	10	6	16	57,14

DISCUSSION AND DATA ANALYSIS

In our analysis, we identified that North American songs appear less frequently than songs from other countries, both in IM and MVW. However, if we consider that, of the MVW, 10% correspond to North American songs and 11% to other nationalities, we can conclude that the North American influence is great, since among the MON, one can find songs of different cultures, continents and countries, while in the 10% of songs that are North American, all are from the United States.

Considering only the nationality of songs, we can note that North American music (IM and MVW) reach a sum of 27.7% of songs, regarded as an expressively high number.

In analyzing these data, we can note that, even with the changes of the CoP (2013-2016) regarding MVW, the individual series of gymnasts at the RIO2016 Olympic Games presented a predominance of IM. However, at least one routines of all the gymnasts presents MVW, which suggests that this change in the Code of Points was well accepted by gymnasts and coaches of different nationalities and continents. Only three (3) gymnasts did not use any MVW in their routines.

Out off 104 songs analyzed, 7.69% correspond to North American MVW; 14.4% correspond to Non-North American MVW; 20.1% correspond to North American IM and 57.6% correspond to Non-American IM.

In the group routines, analyzing the 28 songs, we can note that 17.8% correspond to North American MVW; 21.4% correspond to MVW of Other Nationalities; 21.4% are North American IM and 39.2% are IM of Other Nationalities.

Moreover, we note that IM of Other Nationalities have predominance in these routines. However, North American music still has great influence in the choice of gymnasts and coaches, presenting a significant incidence.

Instrumental music continues to be widely used, but at least one group routines of all countries is executed with MVW, in line with the orientation provided by the CoP, which allows for only one of the two routines to be executed with MVW. Only three (3) countries (Belarus, Bulgaria, and Greece), among the 14 that participated in the competition, used only instrumental music in their routines.

In regard to the use of IM and MVW, in an analysis carried out in 2014 with high- performance Brazilian RG gymnasts, in individual routines, and in junior and adult teams, Oliveira et al. (2015) showed that most gymnasts adopted the change in the code regarding the use of MVW. In this same research, a prevalence of international music was identified in individual routines to the detriment of national music, while in group routines there is a greater appreciation of national music.

Notes about music with voice and words in individual and group competitions

We verified through the data presented in table 1 that almost all of the gymnasts took advantage of the new resource regarding MVW, given that the CoP only allows ¼ or 25% of routines to use it (one

out of the four routines in the competition), a value very close to that obtained in the sample, which was 22.11%.

In the group competitions, the data in table 3 demonstrated the same proximity, for practically 40% of the routines had MVW, given that CoP outlines that one out of the two group routines, or 50%, may use this resource.

This fact may be due to countless reasons. To better understand them, it would be necessary to conduct new research of an essentially qualitative nature, with the coaches and gymnasts that represent these delegations. However, as researchers in the area, former gymnasts and/or coaches, and participants in this edition of the RIO 2016 Olympic Games (as volunteers or spectators), we can bring a few hypotheses that may have influenced the choice of songs to be sung or music with voice and words (MVW):

- to demonstrate adhesion to this new norm of the CoP, as a political position of institutional alignment;
- to demonstrate satisfaction with this norm, given that some delegations and coaches had been making this request to the FIG RG Technical Committee;
- to increase the motivation of gymnasts during trainings and the execution of routines in competitions, merely due to the fact that she will be experiencing something new, or because the "excitement" with MVW is greater, or even because she might have participated in choosing the song (the feeling of owning the decision made is a highly motivational factor), something that unfortunately is uncommon in this discipline;
- harmony with an adolescent and youth tendency (age range of the gymnasts), who have been consuming music at an increasing rate, as a habit in their day-to-day, whether to go out, to rest, to hang out with friends, have fun at night clubs, to pass the time in transit, or in routine activities. A habit facilitated by new electro-electronic technology (celular phones, iPads, tablets or microcomputers) and digital technology (websites such as YouTube, music Apps - online or not, etc.);
- to promote a greater involvement of the public, especially in the case of more well-known music or music "of the masses". It is worth noting, as pointed out in chart 1, that some songs were international "classics", including some of past decades (but known by many generations), of bands or singers such as Queen, Madonna, Cindy Lauper, Michael Jackson, among others. At the start of these songs, the public would generally become excited (they would dance, clap or sing), which might, consequently, also motivate the gymnast and sensitize the jury;
- to reach the jury's subjectivity, whether directly or indirectly, specially when the chosen music is popular, of past generations (and might, therefore, have played a part in their lives), and immersive ("upbeat").

So, choosing the music of the routines is very important, since it will promote entertainment and "interaction" with the public and judges. In Olympic and world games, for example, internationally known songs can attract more applause, animation, incentives, etc., and, in addition, reach the unconscious minds of spectators.

Notes about North American music and its influence in the contemporary world

Independent of whether the songs used by the gymnasts (individual) or teams (group) in their routines were IM or MVW, a strong influence from North American music was verified, as demonstrated in tables 2 and 4.

Nowadays, North-American music is the most played worldwide. Sablosky (1994) attributes this to the country's great cultural diversity and to the fact that English is one of the most widey spoken and broadcast languages around the world, contributing, thus, to the dissemination of North-American music.

Authors such as Trotta (2005) and Junior (2006) bring the idea that, over the years, music has become an artistic product made to meet the needs of the

entertainment, poetics, and aesthetics market of popular culture. In other words, the use of North American music may end up becoming an interesting tool in the elaboration of routines, due to its value in regard to the entertainment of the public and the motivation of the gymnast herself (if she enjoys the genre), demonstrating the choice of songs to be a relevant criterium during the development of the exercise.

According to Brittos & de Oliveira (2005, p. 32), the beginning of the U.S. domain in the music market took place due to the emergence of music-oriented television networks (such as MTV in 1981), the emergence of CDs (1996), and the launch of MP3 in 1999, means of musical promotion created by North Americans, turning the country into a true music industry and music media conglomerate, a huge success in the "appropriation of the incredible localized creativity and from the roots of all musicians". These findings are confirmed by what we experience in our day-to-day, diagnosing the expansion of the North American music market in a variety of social sectors, among which is sports. This presence inundates our day- to-day, when we watch sport competitions of different kinds and in different countries, be they as part of the execution of competitions in different disciplines (as is the case with Artistic Gymnastics, Rhythmic Gymnastics, Acrobatic Gymnastics, Figure Skating, etc.), or during breaks and time requests of different competitions (Track and Field, Basketball, Volleyball, etc.), as for creation of an ambience in sporting events, more commonly known as "background music" (X-Games, Winter Games, etc.), and even in opening and closing ceremonies of sporting events (either of a single or several sports - such as the Olympic Games).

Sablosky (1994) points that North American music is the largest and most powerful spokesperson of its population. In addition to the character of entertainment, this voice presents facts and cultural elements of the country, which, in turn, are transmitted to the entire world.

Junior (2006) defines some important aspects regarding massive popular music, which aligns itself with the artistic concepts brought by sports and that became more evident in the past few years with the permission within the Code of Points to use MVC in routines.

According to Trotta (2005), the consolidation of popular music as the main form of selling records contributed to settle music as a commodity, that is, a product. It is an art form produced and disseminated by certain agents and consumed under certain conditions through a system of compensatory changes in favor of these producers. Therefore, a product meant to be consumed, including in sports.

CONCLUSIONS

The Rhythmic Gymnastics Code of Points (CoP), 2013-2016, was a milestone in the history of this discipline because it was the first to allow vocal music (with instruments or voice) in the routines. That is, after a period of about 40 years, a period of non-exclusivity of instrumental music in the gymnasts' routines begins.

The RIO 2016 Olympic Games was the stage that showed this change, demonstrating its impact on the best world teams.

Thus, this study, which aimed to analyze the impact of this change in the first version of the Olympic Games (OG) that succeeded it, found that this impact was relevant and of high incidence.

The sample comprised of 26 individual athletes and 14 group teams, from the Rhythmic Gymnastics discipline, participants of the RIO 2016 Olympic Games. We analyzed, within a total of 132 routines, the impact of the change in the last cycle of the CoP (2013-2016), regarding MVW.

The documentary sources used did not allow us to identify the reasons why trainers or coaches incorporated this change; we could not identify the reasons

why North American songs were so used in their clear majority by European countries either. These aspects generate concerns for further studies, since only few assumptions could be raised.

There is a variety of reasons that might have led the delegations to adhere to this new norm of the CoP, but a few hypotheses were raised, related to: political aspects (delegations and FIG), motivational aspects (for gymnasts – young and who appreciate music that is sung on a daily basis, and may choose it), to the involvement of the public and the jury.

We conclude that most gymnasts and teams used this new rule of the CoP, and only 3 individual athletes and 3 countries did not. This change was effectively incorporated in delegations of world prominence, sparking a convergence of interests that may still exist between judges, coaches, and members of the Technical Committee of the GR of FIG.

In this process of identifying the impact of this change, the high incidence of North American music (with voice and word or instrumental only) excelled, played by different countries and continents – mostly European ones.

This study brings important evidences to RG, especially with regard to the changes proposed by the technical committee of this discipline (CoP), and its acceptance for the teams of greater respectability and international prominence. Just as it brings new possibilities of new studies about typology of the songs and the reasons that underpin the technical choices of the coaches

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BRAZILIAN OLYMPIC GYMNASTS' PERSPECTIVES ON THEIR PARTICIPATION IN THE OLYMPIC GAMES

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Abstract

This paper analyzes the perspectives of Brazilian gymnasts on the experience of participatingin the Olympic Games (OG) in the Women's Artistic Gymnastics (WAG) competition (1980-2004), using oral history in a qualitative research approach, and cross-sectional thematic analysis. The author interviewed ten Brazilian WAG gymnasts (100% of the sample) who participated in OG until 2004. The gymnasts' testimonials indicated that, as the Brazilian WAG team improved their performance in international competitions, gymnasts' expectations have changed over time, although the dream to participate in the OG was shared by all of them. From the generation of the pioneering gymnasts (1984-1988-1992) to the transitional generation (1996-2000), it is possible to observe several differences related to the pressure to perform well in the competition. While the pioneering gymnasts were not concerned about their ranking in the OG, the transitional gymnasts were reminded of the responsibility to represent their country. For the new generation gymnasts (2004), the participation in the OG carried the burden of needing to accomplish something, to be among the best gymnasts in the world, with actual chances of going to the finals and getting medals in the apparatus finals. Testimonials show their confidence in the work developed by the experienced Ukrainian coaches who led the Brazilian team in the OG in Athens. Gymnasts describe their experience in the OG as having accomplished a mission, feeling at the same time relief, disappointment, desire to return to other editions and some even report the sensation of being lost after returning to Brazil.

Key words: *Women artistic gymnastics, history, Olympic Games.*

INTRODUCTION

Pressure, anxiety, excitement and fascination are some common feelings experienced by high-level athletes. Responses to external stimuli are so diverse and can impact the athlete's performance in so many ways (Durand-Bush & Salmela, 2002; Gould et al., 2002) that the period between the qualification for the Olympic Games and the return home has attracted interest from researchers (Kristiansen, 2015; Delaš Kalinski, 2017).

Studies have pointed out that Olympic-level athletes show great stress before competing (Pensgard, 1997; Pensgaard, Roberts & Ursin, 1999), which can result in physical and psychological changes that impair performance (Wegner, 2000). Orlick and Partington's study (1988), involving interviews with

Canadian athletes of various modalities who participated in the 1984 Olympic Games (OG), describes how mental readiness was an important factor that influenced the performance of these athletes. In this investigation, the athletes reported that their total commitment to pursue excellence, quality of training and quality of mental preparation for the championship contributed to success. In contrast, the same athletes reported that among the three major factors that hindered their performances are increased training load before the OG, the fact that they were selected for the Olympic team weeks before the championship and that they were overwhelmed by the number of distractions such as the exuberance of the ceremonies and events in the Olympic Games.

Similarly, the authors' investigation of United States Olympic athletes (Greenleaf, Gould & Dieffenbach, 2001), found that the main factors that positively influenced performance include psychological preparation, attitudes towards the Olympics, services and facilitation of support, multifaceted preparation, physical preparation and training. On the other hand, the factors that negatively influenced performance were media distractions, problems with the coach, overtraining and injuries.

According to Williams and Krane (2001), most athletes and coaches recognize that 40% to 90% of success is due to mental factors. In this sense, concerned with these factors, some countries (Canada, Great Britain etc.) have offered mentoring programs (Macneill, 2007), and/or intentionally produced pressure situations during training.

We recognize that mental factors play a crucial role in athletic success and we also believe that deep analyses of athletes' experiences at major championships will enable them to better prepare for the competition. However, there is a lack of publications that portray and acknowledge the perception of the athletes themselves on the subject (Schiavon, 2009).

While exploring the process that contributes to the optimal preparation and performance of the Olympic athlete, it is important to give voice to the athletes themselves, what makes the researcher a spokesperson who enables the detailed study of issues related to these life experiences (Meihy, 2005). Thus, so that this scenario can be investigated, this study analyzes the perspectives of Brazilian gymnasts' experience in their participation in the Olympic Games in Women's Artistic Gymnastics (WAG) from 1980 to 2004. However, we intend not only to register these histories of participation, but to deepen the aspects that the gymnasts themselves consider relevant in the experience of representing their country in the championship that culturally is considered the pinnacle of the athletes' carreer in high performance sport.

The Brazilian international results in Women's Artistic Gymnastics (WAG) have improved mainly in the last 15-20 years. According to Schiavon et al. (2013), the first participation of a Brazilian woman in a World WAG Championship was in 1966, with the ranking of Marion Faedrich Dullius in 148th place at the individual all-around. In 2007, after 41 years, the best individual all-around classification happens with a bronze medal from the gymnast Jade Barbosa. We still had, in the Floor Final, Daniele Hypólito with a silver medal in 2001 and, the gymnast Daiane dos Santos with a gold medal in 2003.

In Olympic Games, the Brazilian's rankings in Women's All-around and Women's Apparatus Finals are also improving. The first classification of a Brazilian gymnast to the Olympic Games happened in 1980 (31st All-around Final), with an individual qualification that took place in all Olympic Games until 2000, when Brazil was able to qualify two athletes, followed by the qualification of a team from 2004 up to the last Olympic Games in 2016. In this competition, in

WAG, Brazil secured spots in Apparatus Finals – Floor with the gymnast Daiane dos Santos (2004 and 2008), in Balance Beam with Flávia Saraiva (2016) and the best Brazilian result in All-around Final with Jade Barbosa (2008), in 10th place. Despite the progressive results, Brazilian WAG has not been able to win any Olympic medals yet, having recently won four Olympic medals at Men's Apparatus Finals (one gold/Rings[1], two silvers/ Rings[2] and Floor[3] and one bronze/Floor[4].

This context is due to several factors, among them, the improvement in infrastructure and sports organization in Artistic Gymnastics in Brazil in the early 1990's (Schiavon & Paes, 2012). This improvement is boosted again at the late 1990's with the beginning of the hiring of Ukrainian coaches, forming a permanent national team[5] and investment in infrastructure/gymnasium facilities aiming at Athens (2004) and Beijing (2008) Olympic Games (Schiavon & Paes, 2012). Oliveira and Bortoleto (2009) reported that this transformation is directly related to the rise in financial support from the federal government through the Law 10264 from 2001[66], which transfers part of the earnings from the federal lottery to sports and, also, from Law 11438 form 2006, known as Sport Incentive Law, which allows deduction from income tax of natural persons (up to 6%) and legal persons (up to 1%) intended to institutions which have sports' project approved to captation of resources from this Law.

Even with this positive transformation in the last 40 years, Schiavon and Paes (2012) highlight that Brazilian gymnasts who participated in Olympic Games and began their training in the 1980's and 1990's, in many moments of their sport history, they went through trainings with non-adequate equipment and gymnasium facilities to high performance training, including non-official apparatus. These differences will be noted during the exposition of the current research by the difference in gymnasts expectations about the participation in Olympic Games in different times from Brazilian Artistic Gymnastics.

METHODS

For the development of this qualitative research, we used the Oral History method (Meihy, 2005; Simson, 1988; Thompson, 1992), based on the possibility to collect the life stories of ten female gymnasts all of who competed in the OG for Brazil between the years of 1980 and 2004.

According to Queiroz (1988), Oral History is an ample term that covers an amount of accounts around facts not registered by other types of documentation or which one seeks to complete. Collected through various forms of interviews, it registers the experiences of a single or several individuals from a single collectivity. In this case, a convergence of accounts around a single event or a period is sought (p.19). (Translated by the authors).

This method was chosen mainly due to the lack of available records around the sports development of these gymnasts in documents. In addition, it allows for the collection of detailed information regarding the events experienced in the sports career of each of the gymnasts that might otherwise have gone unnoticed. Laville and Dionne (1999) corroborate this claim.

A known and proven manner of obtaining information, specifically to the

[1] the gymnast Arthur Zanetti (2012)

[2] the gymnast Arthur Zanetti (2016)

[3] the gymnast Diego Hypólito (2016)

[4] the gymnast Arthur Mariano (2016)

[5] From 2002 to 2008, the Brazilian National Federation (CBG) selected gymnasts for the Brazilian WAG team to start a formation process for the Olympic Games (2004 and 2008), called "permanent team", where the Brazilian team trained only in the National Federation

[6] Between 2001 to 2015, the Law 10264 guaranteed that 2% of the gross collection of Federal lotteries in the country, discounted the prizes, were destined in favor of the Brazilian Olympic Committee (85%) and the Brazilian Paralympic Committee (15%). In addition, this Law also determined that, out of the total collected by these institutions, 10% should be invested for grassroot levels and 5% in university sport s (|National Sports Association, 2018).

human sciences, consists of collecting testimony from people who have this information. Recourse to these testimonies allows for the exploration of people's knowledge, but also of their representations, beliefs, values, opinions, feelings, hopes, projects, etc. (p.183). (Translated by the authors).

In oral testimony, the researcher proposes a theme around which to organize the life account of those to be studied (Laville & Dionne, 1999). The research, in a wider sense, is focused on a particular theme, the "history of sports life" of these gymnasts (Schiavon, 2009), and, more specifically in this article, the theme developed, based on the testimonies, as "participation in the Olympic games".

Participants

This research was conducted with the participation of ten gymnasts, introduced below in chronological order starting with the first participation in the Olympic Games: Cláudia Magalhães (1980), Tatiana Figueiredo (1984), Luisa Parente (1988 and 1992), Soraya Carvalho (1996), Daniele Hypólito (2000 and 2004), Camila Comin (2000 and 2004), Ana Paula Rodrigues (2004), Caroline Molinari (2004), Daiane dos Santos (2004) and Laís Souza (2004).[7] The criterion established to determine the subjects was: Brazilian gymnasts participating (or classified) in the summer Olympic Games in WAG up to 2004 (the best Brazilian team ranking at an Olympic Games).

Procedure

Data were collected from a series of semi-structured interviews with the gymnasts that varied in length; the longest lasting 3 hours and the shortest 1 hour. The younger gymnasts gave some of the shorter interviews, could be describe as shyer and as having less time due to the demands of practice. Alternatively, some of the older gymnasts were more confident, willing to go into more detail about their lives and gave longer interviews. The first part in the interview is conducted in a free form, starting with a broad theme, which, in this study, was the sports history of each gymnast (Schiavon, 2009). In a second part, the researcher brings up generating themes, directing the conversation towards relevant issues of the participant's sports history, with the intention of delving deeper into certain subjects. A previously elaborated script focusing on prominent moments of the gymnasts' sports history is utilized in this moment of the interview, and, in the case of this article, the generating theme was "participation in the Olympic games".

Additionally, it is worth noting that access to the gymnasts was difficult meaning that each gymnast was only interviewed once. Contact with them was limited due to their practice commitments and locating them geographically. For example, some gymnasts were living far from the primary interviewer in Brazil, Laurita Schiavon, and one was living in the USA. We acknowledge that access restrictions pose some limitations to the research; however, the thematic oral history method allowed us to make focused use of this time. Additionally, contact with the gymnasts was maintained as much as possible via telephone and email addressed by both gymnasts and researcher. Again, this access varied but the researcher sought to maintain similar levels of contact with each of the gymnasts.

All data were recorded and transcribed verbatim, and each interview informed the ones that followed in terms of issues that emerged.

The present study was approved by the research Ethical Committee of the Campinas

State University Medical School on March 27, 2007, number: 136/2007.

Cross-analysis of data

Of all available forms of interpretation and analysis that oral

[7] The participation in OGs analyzed in the methodological procedures include only the Olympic Games on which the study was focused (1980 to 2004). However, it is important to note that some of these gymnasts participated in other Olympic events, such as Daniele Hypólito (2008, 2012 and 2016), Daiane dos Santos (2008 and 2012) and Laís Souza (2008).

history can be constructed, we decided to use re-constructive cross-analysis (Thompson, 2000) in order to critically explore personal and social constructions, as told through narrative articulations, to produce a multidimensional account of these gymnasts' lives. Thus, the analysis of the results was conducted from the data collected in the field research, in the testimony of the collaborators by themes, in which the units of analysis were represented by the generating theme. Afterwards, each gymnast's data were crossed to allow the relations between them to be established and, from this point, confronted, highlighting and reflecting on the differences and, mainly, the similarities in relation to the participation in the Olympic games of the gymnasts who participated in this research.

Following that, a comparative analysis and a discussion around the data from the testimonies were undertaken, using the basis of information gathered in the literature studied, disagreeing, confirming or even offering collaborations with new approaches. This is the main contribution of Oral History, to bring information that is not to be found in official records or even to disagree with existing records, as new evidence, which might indicate paths for a new interpretations (Thompson, 1992).

RESULTS AND DISCUSSION

For the comparison of participants in this study, we chose to group the testimonies of gymnasts according to similarities in their histories as a whole, an inherent characteristic of oral history as a way of evaluating the coherence of the testimonies. Thus, gymnasts were divided into three groups as follows:

Table 1
Division of gymnasts according to their characteristics.

Group	Description of group characteristics
Pioneer gymnasts	The first gymnasts who represented Brazil in the OG, mainly in the decade of 1980. These gymnasts, in relation to the later generations, experienced situations with less support to the training system as far as it concerns the financial, material and human resource conditions. There was lack of support in these aspects, both in their clubs and in the Brazilian national team. At that time, the Brazilian Gymnastics Confederation had not been adequately structured. These gymnasts aimed at a good performance in the OG, nevertheless they did not have real chances of winning medals, not even of going to an Olympic final. Three gymnasts were in this group: Cláudia Magalhães, Tatiana Figueiredo and Luisa Parente.
Transition gymnasts	This group experienced a stage without support and structure at the beginning, similar to what the pioneer gymnasts had experienced. However, they subsequently had the opportunity to have greater support. The gymnasts of this group even participated in the first important Brazilian achievements in international competitions. Four gymnasts were in this group: Soraya Carvalho, Daniele Hypólito, Camila Comin and Daiane dos Santos.
New generation gymnasts	In this group are the gymnasts who, since they started in the Brazilian team, already found conditions of excellence for an adequate preparation in the sport, in the mold of world powers that compete for medals in World Championships and the OGs. Three gymnasts were in this group: Caroline Molinari, Laís Souza and Ana Paula Rodrigues.

Although all of them shared the dream of participating in the OG, the testimonies show divergence in the expectations of gymnasts from different generations. The generation of pioneer gymnasts felt motivation, emotion, happiness and lack of ambition to fight for a medal concerning their participation. The main purpose of these gymnasts (the pioneers) was to qualify for the OG and, if possible, to improve their final result:

> We went to the Olympics, my coach and I, and João Luis[8] with his coach. It was really cool, I also managed to compete well, despite being there alone, without a team. Olympics, it was heavier, and I didn't even care, I just wanted to train, train and do my best. It's funny because I didn't commit any mistake and I managed to qualify for the all-around finals. [...] I qualified in the top 36, think I was placed 33rd, but I have to see…it's been so many years that I don't know, I think in the finals I was ranked 30th [9]. [...] It was awesome, in the first time! Finals, first time too. [...] I didn't get stressed out, it was just happiness (laughs), and our mood in Gama Filho[10] was pure motivation, joy, great love, the coach was so kind, he was our daddy, he was very funny, he was tough but very playful (Cláudia Magalhães).

> At the Olympics it was very cool. Because it was my dream come true. What I'd been looking for, that I'd been looking for my whole life. Despite all the difficulties, it was very nice. It's a shame that at that time we didn't have good conditions. Brazilian Olympic Committee didn't have many resources. So they just wanted to send the athletes who had a medal chance. I even had to go through an evaluation before the Olympics. Berenice Arruda did it, I got (a score of) 9.50 and they sent me, but they didn't send my coach. Only one coach, female or male, could go. So the male gymnast's coach, Mário Pardini, went with us. Then, Brazilian Gymnastics Federation (CBG[11]) extra-officially hired Lílian Carrascoza (coach) and she had to stay out of the village. [...] I did well, but I did better in the all-around finals. [...] I was ranked 27th. The goal was to get to the final, to be among the top 36 gymnasts (Tatiana Figueiredo).

> And there in Seoul, our goal was to be among the 36 finalists. And then I qualified in 34th. So I'd hit the target and then I fell one position on the days of the finals, to 35th. But it was very good and it was one of the most exciting moments because I was there, waiting for the score, the names were been displayed, the finalists' names. [...] So, in Seoul - 1988, looking at the scoreboard, in the last call, 'cause they were showing from eight to eight, then in the last frame they showed my name there. So I went on to the third day of competition. [...] The target I had was to be among the 36 finalists and it was 35th, so it's great (Luisa Parente).

> In Barcelona, the expectation was the same. We didn't know our reality. In the Olympics there was still no way to get a medal, to fight for a medal, but we could improve the ranking. So the goal would be to get among the top twenty, maybe. Then, technically, I'd grown up a little more than I expected, I was already nineteen, but I was great. An athlete, strong and everything. And my compulsory[12] routines were very good, which created this expectation of achieving it. But then, in the food hall, I fell in love with Magnum (laughs), the Ice Cream.
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> [...] In fact, I was training in Madrid, 'cause we would spend a month in an exchange program before the Olympics. And then, there I was, I was ok, ideal weight. And on the day of the Olympics, when the competition started, I was two kilos over my weight in Madrid.
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> In the competition, the first exercise was Balance Beam, first entrance, compulsory routine, press to handstand. Then I went up, but I came back and fell. Everybody was: oh! And I: ah! And now what? That fraction of seconds: "This is past, this is already gone, it's past; now all you have to do is the best you can to do in your life, you have to compete like you never did anything in your whole life." I kept on trying to do this in the next steps, still a bit tense! But I managed to finish the beam routine. Then I went on, Floor, Vault and Bars, and it was the highest score of my life:
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> 9,812. Compulsory routines. So, it shows how to overcome a totally adverse circumstance. First, the Olympics were like this, the last Olympics, probably... and you fall! So, I overcame it very well and went on to the optional routines, and they were good. Now, in the final ranking, I was placed [...] 40th. So

[8] Male Brazilian gymnast competing in the Moscow OG (1980).

[9] In fact, she was ranked 31st.

[10] Gama Filho was the name of the university where this gymnast used to train.

[11] CBG is the acronym in Portuguese

[12] Until the OG of 1996, the gymnasts had to perform compulsory exercises in the preliminaries to show a minimum technical level. Therefore, the compulsories were performed on the first day of the team competition. Nowadays, this type of competition is no longer in the international program of WAG.

I almost got in the group of 36 finalists. But that's occupational hazard. (Luisa Parente)

In the transition generation, there was a frustrating event that involved Soraya Carvalho, who unfortunately could not give her testimony about her competition, since she could not compete due to a stress fracture injury in her leg, diagnosed on the eve of the WAG competition in the OG. Obviously, Soraya holds a lot of resentment and sorrow about this event, her frustration and the process she had experienced while preparing for the OG, culminating in this injury that took her out of the competition. Therefore, it was possible to report only the process of diagnosis of her injury and her treatment, which she tried on the eve of the competition:

This story's very exhausting. When I got there at the Olympics, I talked to the CBG President and said: "I'm so tired", then I was really worried. Because I'd competed with an injury so many times… and you go. You know how it is. But this time I was really worried because I would not be able to go like that. The pain was very sharp. When I arrived, I went straight to the doctor, they took an x-ray. Then they did several other tests and so, and they said: "apparently, if she rests her foot for two days, if it is possible for her training, maybe she can compete. Let's try!". All this with intensive care. I had the delegation's physiotherapist inside my room in the village, every hour and a half he would put ice on my foot. He was on duty the whole night, a treatment to see if it would get better. And, in the meantime, in the training schedule I would go to the uneven bars, to do part of the physical training. Without touching on the ground, I was on a crutch, already.

After the second day, my calf had great swelling reduction. But then, it was a deep bruise. Then the doctor said: "let's do an MRI". So they saw that I had a stress fracture and was bleeding in the growth areas, I'd almost had ligament rupture, and the tendon [...]. So it was very serious, a very, very serious injury. And that's when the medical chief said: "look, she's a young athlete. It's very serious. The fracture is large and maybe, depending on the way she falls during some exercise she may have a compound fracture, and then need surgery, so, let's spare her and maybe she can attend the upcoming Olympics." And so it was over. (Soraya Carvalho).

As for the other two gymnasts from the same generation, it is possible to observe the difference between the expectations to participate for the first time in Seoul and for the second time in Athens. In Seoul, their main concern was still to participate and improve their result. On the other hand, in Athens this situation was changed by the pressure to represent the country well: "In Sydney I competed well! Like... I was still very young, I was not used to such a large audience [...]" (Daniele Hypólito).

There in Athens I competed very well. So I was very happy with my competition. We felt the pressure, we tried to talk to Dai (Daiane dos Santos), and everything, so that she didn't feel so pressured and in the end we shared some of that pressure to try to relieve her. But it didn't work. Because, I think, after she was a world champion, the TV was on her. So it was pressure from everywhere. And then it turned out that the rest of the group, actually, felt no pressure because we had a team to do our part. To represent our country well and to show that Brazil's gymnastics was there to stay. It had come to keep on as a team for many years, having a team qualified for the Olympics.

In Athens it was different, we had other coaches. Iryna went to Sydney and to Athens, but then she was with Oleg, it was a different structure, we had a team, our concentration was totally different from what we'd had in Sydney because I was older, I already knew what I wanted, I was no longer that (sigh) fascinated because I'd already been to one (Daniele Hypólito).

After qualifying for Sydney – for me, in my head, the Olympic Games were that dream, the dream of a perfect competition, a calm competition, because I competed giving my best, my goal was doing well. And in Athens the goal was the qualification (team and individual all-around), so there was more pressure, as in the finals, I had it myself, and the country too, because Brazil wanted the qualification, not only Daniele Hypólito... they wanted us to stay, the goal was another one, it was not only to participate[13], the goal was to compete. So [...] now we wouldn't enjoy the championship, we would compete, then the six days of competition

[13] When the gymnasts say "participate" they mean just being part of the Olympics, knowing that there is no real chance of winning a medal.
When they say "compete", they mean participating and fighting for a medal or for a good result.

were six days of stress, so it completely changed my concept of competition, of Olympics. It was in Athens that I saw that competition was not a joke, that competing was not what I had imagined, that war was not simply for the medal, it was a war that only who could stand it won, it was a full overcoming. It is the limit of the limit of the limit. If you are there, it's not for money, money doesn't buy it, it's simply talent and overcoming. So, for me these Olympics (in Athens) were very important because we were there, the six of us, and the six girls wanted to be there, but at the same time we didn't know that, to get there, we would need so much. So much effort, to go through so many barriers, because nobody says this. The dream is there, but for you to get there, you don't know that the way is very difficult. Nowadays I appreciate people who were athletes because it's not easy, only who's an athlete knows it (Camila Comin).

There in Athens, in the first Olympics really competing, I think it was really cool because we had a team. It was a strong team. The group was strong. We were among the best in the world. The twelve best in the world. And we ranked 8th! We were the 8th best team in the world, so we had to show something. We were supposed to show more good things. Not to mention that I went to Athens with this team and I still could be Olympic champion on the Floor. All that! So I guess it was something that happened too fast. That we said: "Everything happened so fast!". I guess. At least for me, I think. If you count, I have a background of twelve years of Gymnastics. [...] Thirteen years of Gymnastics. [...] The evolution was nice because I got it from the beginning, when we had nothing in Gymnastics. Nothing. And now we just have about everything. We have sponsorship, we have a good training place, we have a real preparation with good conditions.

It was pretty cool in Athens, but it was very intense. It was a stage in my life like… very tense. Because there was that expectation, an expectation of millions of people at the same time. So that was a very stressful thing. My focus was all over there. In Athens, on the Floor mainly, as it was my strongest apparatus. Not that I trained more for the Floor exercises, but the main focus was on the Floor. But it was hard. I think I lacked maturity! That the fact that I grew up in Gymnastics, it's the maturity you have. [...] It's hard to know how to deal with pressure, it's hard to cope with it, all there in your hands. Because at that moment I had everything in my hand. It was that thing: if you don't make a mistake, you're going to be the Olympic champion. [...] And it was one extra step that spoiled it. It was not even lack of power, it was the power that was too much! So I guess you are gradually gaining maturity. But only that doesn't help! You get it when you win competitions. Only when you compete once there you'll you keep gaining it. (Daiane dos Santos).

In the new generation of gymnasts, their beginning in OG already suffered great pressure to conquer something and to be among the best, unlike the previous generation, who were in the process of transition from the context of participation of individual Brazilian gymnasts in OG without medal chances, to a team with real chances of qualifying and fighting for a medal in individual finals.

There in Athens I got a stress fracture in the shank, so I was really bad, I could barely step on the floor. I had physiotherapy, took medicine, calcium capsules to try to recover, but I felt a lot of pain. Nobody knows this, people never see this side, and you start to get overloaded: "it's coming", and you're in pain and you start to get desperate. But I had to train the same way, I had to stand the pain. The competition there was not very good for me, because I competed on the beam only. It was terrible, I didn't like it. I used to do 10 routines without any falls or balances problems every day to get to the competition and do that?! [...] That crap! I fell two or three times from the beam, because I was extremely nervous, terrified, I had nervous tics at the time of the competition and it was an inexplicable thing, because I used to do

10 routines without any extra movement in the training, all perfect. Even with my injured leg I used to do it. But it happens... just like Daiane dos Santos, who failed on the floor right at the end of her routine, everyone's subject to it! Later we got really upset because we'd trained so much, so much and we missed it for very little, just 0.10[14]. (Caroline Molinari).

I think I could have done better there, but, like, it was the first time, and I, as always, was the youngest in the team, so it was ok for me. I really liked it. I don't get nervous to compete. Sometimes I can look tense, but I'm calm, I can control myself, even at the moment I was going to mount the beam, or like the uneven bars. But to watch Daiane I wasn't nervous. When you're out of the competition, it's a big stress, my gosh! I almost died! (Laís Souza).

[14] Due to a difference of 0.10 points, Brazil did not rank among the eight best teams to compete in the team final, it was ranked in 9th place.

> My competition was much better than the training, because in the training there is a lot of pressure, and everyone there is looking at you. It makes you nervous. It's different. It was difficult at first, but then we got used to it. We talked about all this pressure, because it's hard for you to be there, you have to train well, because there's always a judge watching you, a coach watching you. And you can't cry, you can't complain. It was more difficult. Are you gonna cry? [...] We knew we couldn't. I wasn't as nervous as I thought I'd be. [...] So I always started to compete in the group, because I was the most calm and I did it like this, calmly. I didn't have that much trouble. So we started on the beam. I was the first one. Then I was very nervous because that gym was huge, there were so many people watching us. It makes anyone nervous, but I did very well. I competed. I didn't fall. On the Beam, I only had one connection that I missed, but I didn't make any mistake. On the Floor it went well, on the Bars, my best apparatus, I performed a flawless routine, let's say. I didn't make any mistake and did everything I had to. And as it was my best apparatus, it was very good for the team. And Vault was also good, I didn't make any mistake. So since it was our first Olympics, and our team was very strong like this, well prepared, I think we gave our best. There was no serious fault. So they (the coaches) were ok. They told us that we competed very well, and since the other teams were stronger, we couldn't go to the finals. It wasn't our time (Ana Paula Rodrigues).

The pressure to be part of one of the best teams in the world triggers a feeling of anxiety that is often uncontrolled, as Caroline Molinari said, which ended up getting out of control just at the time of competition. Ana Paula Rodrigues also mentions the fact that they were observed by other teams, by the judges, as they had become important gymnasts, prominent in the competition. Another situation that all the gymnasts who participated in the Athens OG mention is the pressure on Daiane dos Santos, a gymnast that was fighting for a medal in the Floor competition, something that no Brazilian gymnast had done before in OG. This context was totally different from Cláudia Magalhães's, who mentions her calmness and fun in the competition, while still fulfilling her role, but with smaller responsibility for the WAG level of her country at that moment.

From the generation of pioneers and the transition to the new generation, there is a great difference concerning the pressure to have a good competition, mainly because of the possibility of better results for the new generation. The pioneer gymnasts showed disregard for the final qualification, so that Cláudia Magalhães herself does not remember exactly her qualification in the OG – a fact that is unimaginable for a gymnast of the new generation, who knows where she wants and where she needs to reach, because there is already a higher responsibility with her country, since it expects results. Tatiana Figueiredo reports that, after her qualification for the OG, she returned to Brazil to get prepared during the last year because the trainings in the USA were very strong, which can demonstrate that the main and more difficult task was the qualification itself. After she qualified, the goal was to represent her country, but without any prospects, only to participate (not to fight for a very good result). Similarly, while addressing the issue of the weight gained in the Olympic village, Luisa Parente shows disregard for a possible negative result in her performance, as she was not so motivated, which emphasizes the idea that the participation itself was the greatest achievement until that moment.

Some testimonials explain details about the training in the OG or during the preparation for them, such as Cláudia Magalhães in the OG of Moscow: "The training was not strong, it was ok, it was light, just for testing the apparatus, the distances to run and to measure where the vault run starts and where the mounting begins" (p.15). Other gymnasts also approach the subject:

> In the OG (1988), I confess that... my mother remembers I'd told her that, if there would be one more day of competition, I wouldn't have stood it. So maybe I was like that, actually, either at the peak, or maybe already in a descendant phase of my physical condition, but then it was like that, and I think it was the right thing. My mother even thinks it was too much for me. The best thing would be being at the peak all the time, and not

being already in that... (tiredness expression). But it's too hard. Especially for a coach who didn't have that experience. I think Brazil didn't have a school and everything, so I think the goal was achieved, for sure (Luisa Parente).

The trainings there were all scheduled. We arrived there and they'd already made all the training schedules, with the local where we would train. We trained in the mornings and in the afternoons. In the morning in a gym, in the afternoon, in the other gym. It was hard training. On the first and second days, it's always to get used to the apparatus. We don't perform a complete routine, but if the person arrives and already gets adapted to the apparatus, they can perform routines already. But it was shorter than here, because, as there were several teams, several countries, there wasn't so much time for us to stay in the gym. The trainings were shorter (Ana Paula Rodrigues).

As soon as we got in Athens, the trainings were not as hard as they used to be, because the day before the competition you can't, then there are the schedules and everything to train, but we had all the tasks that, if they weren't fulfilled, we had to do the next day. They'd made it for us and we had to follow that training plan. [...] And we got it not because we were lucky, nothing was in vain, we'd trained very hard. Only we who train, we know what we go through. Each one of us always remembers how difficult it was, really training a lot. A lot of training, exhausting, I would get to the end of the day completely exhausted, I was not even in the mood to go up the house stairs, it was really exhausting, but it was worth it, it worked out (Caroline Molinari).

The training there at the Olympics (2004) was tough. The same thing! It was very hard because it was hot, very hot, and the gym was usually very bright. So much light came in that it even hurt the eye. And I think the most difficult part of Athens was to get used to the apparatus, 'cause they were JF (Janssen Fritsen), if I'm not mistaken. The beam was ok, and the bars, people on the third day were more or less sort of getting used to it, everybody. Vault had a very hard board, and the floor was more or less ok also, but it was kind of soft (Laís Souza).

It should be noted that the Brazilian media started to pay more attention to WAG from the Seoul OG, with Luisa Parente, who mentions that the media in Brazil was interested in information and in broadcasting images of this sport from that time on:

In the competition in Seoul, crowded gym, everyone was watching and valuing all the athletes who were there. And the press, I remember the Brazilian press was also trying to follow every moment. I still remember now. The videos, you see some comments – still unprepared, a lot of ignorance. There wasn't this specific commentator thing that we have today. Because it's really a lot of information for each sport. But the Brazilian journalists already recognized this sport. It really stirs the emotion, because the Brazilian people especially love to follow it and cheer. So, that was wonderful.

Another important issue of this study concerns the statements that show some fascination with the OG. This fact was reported in different generations:

It was a party, the most beautiful things in the world, it was all rosy in Moscow. I'd never seen so many flowers in my life, everything was decorated with that summer of flowers, the people seemed not to suffer at all: always smiling, beautiful, happy, waving to everyone, I was in paradise. Then I started to have my few hours of free time to stroll in the Olympic village and buy things and those "Misha" animals (the Moscow Olympic Games mascot – a bear). [...] I had to concentrate because, at the time of training, I only trained, trained, and had some fun too (Cláudia Magalhães).

In Barcelona, as I'd already participated in Seoul. I also think that, because it's a city of Spain, the environment, the climate was more like summer. It wasn't cold. In front of the beach, wonderful weather! Beautiful city to host the Games. Everything was very nice, very festive. So it was a very, very nice environment too. It already had a high level of structure, also. That gave you a status like, really: My gosh! Athlete! This importance (Luisa Parente).

We were under the same pressure together. When it was decided that I would go, I didn't believe, I didn't believe it was me who was going. The trip to Sidney, from boarding time till the moment I had to compete, for me it was a dream, everything for me was beautiful, everything for me was a sea of roses. The Olympic Village for me was an unforgettable place, the athletes who passed by me, and I was drooling, do you know that child who gets the first toy?, for me, everything I had gone through, everything that was bad, the fact that I'd cried in the training because of pain had gone, it was erased, it was kind of, like an eraser. [...] Competing there was a relief. Because I finished, I can start all over again, as I have already achieved what I

wanted, which was my peak, it was the Sydney Olympic Games (Camila Comin).

In my first Olympic Games, everything was new, It's something I remember more of the first Olympics than of Athens itself, I think because it was the first Olympic Games, I was known as the mascot of Brazil, so I ended up getting to know a lot of people because of this, cause everyone wanted to know who the mascot was, I was very small, I had turned... better gift than this was to turn 16 during the Olympics. [...] Athens was as remarkable as Sydney was, because it was my second Olympics. But I think it was not that remarkable and I was not as dazzled as I was in Sydney (Daniele Hypólito).

Ah... I think the Olympics is a competition that everyone expects to happen. And when we got there… Wow! Everything is different there. It's very beautiful. [...] We arrived and stayed in one single apartment: the Brazilian Gymnastics team: the girls, the coach and the coordinator in a bedroom. It's one cafeteria for everyone and then we see all countries, all the sports, it's a very different thing. Pictures all the time! Camera in hand! There's a shopping mall there, small shops, it's really cool (Ana Paula Rodrigues).

Three gymnasts did not report this fascination as the previous ones: Soraya Carvalho, because of the injury mentioned previously; Caroline Molinari, possibly because she did not have the performance she wanted in the apparatus she could compete because she had a stress fracture in her leg; and Laís Souza, who says that the gymnasts who had already participated in the previous OG had anticipated so many things that she felt higher expectations: "Actually, we arrived there in Athens and it was not that big deal: Wow! It was normal for me".

The fact that most of the gymnasts in this research mention more details about the place, the entertainment of the Olympic Village than about the competition itself or their performance as athletes emphasizes the fascination with the OG, result of the dream of participating in this competition that is so valued by society. Medina and Sánchez (2003), quoted by Bortoleto (2004, p. 378), emphasize this value: "It is an indispensable condition to begin a long road to the accomplishment of the sport's myth of victory, of fame, of becoming an idol and, as a consequence, becoming eternal.".

This fascination may be an inevitable factor for different countries, with different athletes and sports, but possibly, for a country that does not rank significantly in the count of medals, it has a symbolism of something that is unattainable, heroic, powerful, more than it does for other countries, as they can see the OGs as something more possible, perhaps more common, with real chances of winning medals. What may increase this fascination is the fact that an athlete from a country considered a world sports power is prepared with all the right conditions to get a medal. On the other hand, a Brazilian athlete's conditions in the whole process of sporting training were probably not the most ideal to reach the OG, and yet he or she managed and got qualified anyway. This situation of being among the best in sports may contribute to this fascination of athletes in general, which can generate a loss of competitive focus.

The English Institute of Sport (2008) develops a psychological work with potential Olympic athletes, called "elite learners", preparing them for the pressure of such an important international championship, aiming at a psychological preparation for the OG, mainly for the London Games (2012), when English athletes competed in their own country with greater pressure than in any other Olympics. This institute develops courses with coaches and athletes, suggesting the implementation of pressure situations during the training itself.

This type of training, given by the Ukrainian coaches, was mentioned by some gymnasts in the present research. It consists of performing routines sometimes without warm up to be evaluated, or on some days when the coaches are colder and more demanding, like in a theater play, so that gymnasts feel greater pressure and the coach can notice how they react in these situations. Camila Comin comments on this preparation in her testimonial:

> Then, four years with them (the Ukrainian coaches) seem to be eight. Training is very different, the training pace, the training goal, the cold way they work with us. This coldness also changed in four years. If you ask me if I have changed, from when I was a kid to today, I have totally changed, I am no longer the same person, nor the posture, the discipline, the responsibility, how to act when close to people, the concept of life, of person, of work, of how you put a person on the edge. Of stressing the person until the person says: enough! Don't go any further! I know what my limit is, I know I'm here, but I can go just as far as here, since I know I can go beyond my physical knowledge. I think I can stand that much! No! I can stand a little more, but this more... this distance between a double and a half (jump with twist on the longitudinal axis) for a triple, it's half twist, but that half twist... it's half twist. It's this limit that I've learned to see, not only in my personal aspects, but in my study, at work, in the people, at home (Camila Comin).

The English Institute of Sport (2008) has a program called PRIDE (Personal Responsibility in Developing Excellence), in which athletes who have already finished their sports careers, who have already experienced these pressure situations in other OGs and have been able to deal with them, try to pass on their experiences to the athletes in training for the OGs in order to prepare them for different situations experienced in these environments in a process called mentoring, as counseling. This preparation is developed by the performance psychologist of the English Institute of Sport, Pete Linsay. The same mentoring work was developed with Canadian Olympic medalists in preparation for the Winter Olympics and it was considered by athletes to be of great assistance to concentration, the focus on the competition (Macneill, 2007).

In a way, Laís Souza's lack of fascination may be the result of the counseling process of the gymnasts who had already participated in the Sydney Olympic Games and who, perhaps without this purpose, but in a spontaneous way, may have developed this counseling process, anticipating what she would find in the OG. Thus, it is possible to perceive the seriousness and certitude of the work developed with the Brazilian team in Athens, in which there was an orientation and a certain goal carried out with the experience of those who have already lived several periodizations for the OGs. Camila Comin emphasizes the difference in her participation in the OGs of Sydney and Athens, saying that in 2004 the objective was no longer to participate, but to fight for a good result, a difference also observed in the generations prior to Sydney, for whom the objective was only to take part.

And after the OG, what was the feeling left in these gymnasts? For some of them, accomplishment, relief, others feel disappointment and others want to come back in other editions. They are different feelings, from the experiences of the days the athletes had in the OG: "After the Olympic Games, I wanted to go to the Olympics again. After we go to the Olympics, we can't stop, it's much, much pleasure, the most wonderful thing in the world. And I said, 'I'm going again! This thing is too good.'" (Cláudia Magalhães).

> So it was very exhausting because I had this result and this result for me was very ambiguous. Just as it was very sad, for me it was a relief, like: "Oh, thanks, God. I won't need to make any more effort. I won't need to train any more. That's enough." (Soraya Carvalho).

> When I came back, the plug fell. I already did it, and now? What am I going to do, where am I going to go? I got where I wanted. What do I do now? It ended like this, when you accomplish a goal and that's it. There was nothing forward. I'd never thought of myself. For me, my life would end there, as if the world ended in the year 2000 (Camila Comin).

> We got upset, but at the same time that you get upset, you're happy because it's over. You get upset, but you feel that happiness: thank God! I'm not gonna practice like crazy! It's over, you know? You feel this relief, it doesn't matter the outcome, you really feel relieved. But we couldn't ease it because we still had Dai (Daiane dos Santos), she was in the Floor final. So, until the last day we were with her, eating less and everything, you know (Caroline Molinari).

Soraya Carvalho and Caroline Molinari's feeling of relief may demonstrate that their goal of participating in the OG, the responsibility of representing their country, was perhaps greater than the pleasure of being there. On the other hand, the researchers observe positive feelings of appreciation for the OG in Camila Comin and Cláudia Magalhães, including the fact that Camila Comin was so anxiously waiting for the moment of her participation in the OG, as the main goal of her life that, when it was over, she felt lost, a feeling that occurs also in many gymnasts when they finish their sporting careers. In turn, for Cláudia Magalhães, it was such a pleasurable experience that she came back strongly willing to participate in the next OG, but, in fact, it did not happen.

CONCLUSIONS

Based on the fact that the objective of this article was to analyze the perspectives of the Brazilian gymnasts on their participation in the OG from 1980 to 2004, the contribution of this study is to present and analyze data that did not exist hitherto, since there is little appreciation of the gymnasts' voices, their feelings, their perceptions on the sports preparation system in general. Furthermore, there is no record in literature of previous publications on the subject of Brazilian gymnasts with such detail, as it is required for the type of research and method chosen. On the other hand, it is important to emphasize that these registers show some gymnasts' view on the context they lived in, therefore the study presents only the specific perspectives of a select group of Brazil's best gymnasts between 1980-2004.

In the analysis of these three generations, it is important to highlight that they were decisive for later generations, who have already enjoyed a better sporting structure for Artistic Gymnastics, with better training conditions and preparation for international championships. We still lack structure in several AG gymnasiums in our country, besides the lack of professional training for coaches in a broader range (Lima et al., 2016; Carvalho & Schiavon,

2017). However, at least for gymnasts of the Brazilian team, since the 2004 national team, Brazil already offers financing for an international level of preparation in AG.

As we analyze the progression of the ten Brazilian gymnasts who participated in OG from 1980 to 2004, it is possible to notice the increase of the pressure for results, consequently followed by greater monitoring from the media and a greater dissemination of the sport in Brazil after the 1990s, and its apex was Daiane dos Santos' Olympic final on Floor exercise in 2004. The increase of the media interest about WAG, besides the positive aspect of the publicity for the sport in Brazil, also triggered greater pressure in the athletes, which was something new for the gymnasts in 2004, who were not used to the exaggerated approach of the media.

This study has some limitations: first, because this article presents the perspectives of the gymnasts, without considering other subjects who lived in the same context. Besides, the data portray the conditions of the most prominent gymnasts in Brazil from 1980 to 2004, which may not represent the Brazilian reality as a whole, and therefore cannot be generalized. Nevertheless, it enlightens sports professionals and managers, and the directions to take so that AG becomes a sport of excellence not only in Brazil, but also in emerging countries considering this sport, or even for countries that are already developed in this field, but whose gymnasts we have not heard for a scientific analysis yet.

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CRITICAL ANALYSIS OF THE PERFORMANCE OF WOMEN'S ARTISTIC GYMNASTICS IN BRAZIL IN THE 2004-2016 OLYMPIC CYCLES

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Original article

Abstract

Women's Artistic Gymnastics (WAG) in Brazil has been represented in the Olympic Games since 1980; however, a full team was classified only in 2004. Analyzing the Brazilian team's participation over the last four cycles (2004-2016), we have identified several factors that implied in the WAG results. In this study, we discussed these factors and reflected on their contributions to the development of the gymnastics. The milestone of the 2001-2004 Olympic cycle is marked by the first participation of a full team, when foreign coaches came to lead WAG, the training system was reorganized, and the selected athletes began training in a centralized training system in Curitiba's Training Center. The 2005-2008 Olympic cycle was more successful, as a consequence of the long-term planning. In the 2009-2012 Olympic cycle, the Brazilian WAG went through a period of turbulence, the training was no longer centralized, and the head coach of the Brazilian team returned to his home country. In the 2013-2016 Olympic cycle, with the headquarters of the 2016 Olympic Games in the city of Rio de Janeiro, the Brazilian Olympic Committee devised strategies to boost the country's success, which again drove improvement in the team results. We concluded that the last Olympic cycles represented a major advance in Brazilian WAG. Restructuring since 2000 has been paramount condition for the gymnastics discipline to reach the current level. The improvement in training and competition conditions, the structuring of a Training Center of excellence, and the multidisciplinary team support was essential for the preparation of Brazilian team in the Olympic Games.

Key words: *Olympic Games; Long-term planning; International Acknowledgement.*

INTRODUCTION

Artistic Gymnastics is a traditional sport included in the Olympic Program since the first edition of the modern Olympic Games in 1896 in Athens (Publio, 1998; Kerr, 2003). On this occasion, only men participated, and women began to compete later, in the Amsterdam Olympic Games in 1928 (Publio, 1998; Kerr, 2003).

The International Gymnastics Federation was founded in 1881 and has been organizing and regulating gymnastic sports since then (Publio, 1998; Kerr, 2003).

The code of points, elaborated by the International Gymnastics Federation Technical Committee, regulates competitions in the high level of sport (International Gymnastics Federation [FIG])

(2017). This instrument is updated every Olympic cycle, and changes are constantly being made in order to keep Artistic Gymnastics attractive to the public and media and to stimulate its evolution (FIG, 2017).

In official competitions, the gymnasts are currently evaluated by a panel composed of nine judges (FIG, 2017). The criteria evaluated are: the difficulty of acrobatic and gymnastics elements, technical faults in the execution of the elements, the aesthetics of the movements through observation of the posture and alignment of the body, and amplitude and dynamics of the movements. Furthermore, on the balance beam and floor exercises the judges analyze the artistic component through the choreography, expression, and musicality (FIG, 2017). Thus, the starting value of the gymnasts is determined by the difficulty value of the routines added to the value of execution, which starts from 10 points. We emphasize that there may also be deductions for general faults, which are not related to performance (FIG, 2017).

Artistic Gymnastics arrived in Brazil in 1942, brought by German immigrants living in the state of Rio Grande do Sul, where the first gymnastics federation of the country was founded. The gymnastics discipline spread to the states of São Paulo and Rio de Janeiro and, in 1948, these first three federations joined the Brazilian Sports Confederation. In 1951 the Brazilian Sports Confederation joined the International Gymnastics Federation and the first Artistic Gymnastics championships were organized in the country (Publio, 1998).

In Brazil, Artistic Gymnastics began to develop in 1966, and Marion Faedrich Dullius was the first gymnast to represent the country at the World Gymnastics Championships in Czechoslovakia. In 1978 the Brazilian Gymnastics Confederation was created and, for the first time, Brazil was represented by an women team in the World Championship. The highlight of the team was the gymnast Lilian Carrascozza, who obtained the world-class gymnast recognition from the International Gymnastics Federation, awarded to gymnasts with a score of 9 points or higher (Publio, 1998; Schiavon, 2009).

Thus, gradually, the Brazilian WAG has increased its participation in the largest international championships and, since the Olympic Games in Moscow in 1980, it has been represented by at least one gymnast.

In 1980, Claudia Magalhães was the first Brazilian gymnast to compete in the Olympic Games. In 1984, Tatiana Figueiredo participated in the Los Angeles Olympic Games. Luiza Parente represented the country in two consecutive Olympic Games in 1988 and 1992, and we highlight her brilliant participation in the 1991 Pan-American Games, in which she won two gold medals. In 1996, Soraya Carvalho qualified for and went to the Olympic Games in Atlanta, but due to a stress fracture of the tibia, discovered four days before the opening of the Games, she was unable to compete. In 2000, in the Olympic Games, in Sydney, Camila Comin and Daniele Hypólito represented the country (Schiavon, 2009).

It was a process of constructing the sport until the athletes became more expressive in the international scenario and reached the technical level to compete with major top class gymnasts, such as the United States, Russia, Romania, and China.

We also highlight the importance of this generation of gymnasts for the restructuring and development of WAG in Brazil since 2000 (Brazilian Olympic Committee [COB], 2003); (Schiavon, 2009; Schiavon et al., 2013; Schiavon; Paes, 2012). In addition, we observe the effects of the 2001-2004 Olympic cycle on the evolution of this sport in the international scenario (COB, 2006; Schiavon, 2009; Schiavon et al., 2013; Schiavon; Paes, 2012; Nunomura; Oliveira, 2012).

Many changes occurred during this period and corroborated this evolution, such as the investments never seen before in the history of Artistic Gymnastics in Brazil. Currently, gymnasts have proper conditions to excel in the sport, as access to technology, financial support, and a

multidisciplinary team (Schiavon; Paes, 2012; Schiavon, Paes, Toledo & Deutsch, 2013).

A fact that calls attention to this evolution is the creation of the Excellence Training Center, which ran from 2001 to 2008. This Training Center was inspired by the Russian model of centralized training, in which the selected gymnasts trained intensively in the format of boarding schools in a place with offered proper infrastructure for high performance sport, allowing direct control of the training and other aspects involved in the development of an elite athlete (COB, 2006; Nunomura & Oliveira, 2012).

The Brazilian Gymnastics Confederation began planning the Training Center in 1995 with the support of the Brazilian Olympic Committee (Nunomura & Oliveira, 2012). The construction of this place began in 1997 and in 1999 foreign coaches came to coach the WAG Brazilian team (Nunomura & Oliveira, 2012).

Among the hired coaches there were those who succeeded at international scenario and are very recognized due to their expertise, an important factor for the technical development of WAG in Brazil (Federal Council of Physical Education [CREF], 2004). The combination of these renowned coaches with Brazilian gymnasts has given greater visibility to Brazil in important competitions, since they call attention from the judges, spectators, media and stakeholders (De Bosscher et al., 2009).

The first foreign coach who came to work at the Curitiba Training Center was the Ukrainian Iryna Illyashenko, followed soon after by the choreographer Nadia Ostapenko, and in 2001 the coach Oleg Ostapenko arrived, who produced countless Olympic champions and served as head coach of the Brazilian WAG team.

Oleg's staying was supported by the Olympic Solidarity Program of the International Olympic Committee, which paid the salaries (COB, 2006), and the political influence of the then president of the Brazilian Gymnastics Confederation, Vicélia Florenzano.

The costs of the Training Center included the technical committee and the multidisciplinary team accompanying the athletes, maintenance of the gymnasts, infrastructure of the place and international exchanges. The expenses were funded by the resources of the Agnelo Piva Law and Brazilian Gymnastics Confederation sponsors (Oliveira, 2010).

In 2001 the selected gymnasts began to train in the Training Center in Curitiba, a fact that standardized the team and contributed directly to the evolution of WAG in Brazil (Nunomura & Oliveira, 2012).

It is important to emphasize that the evolution of this sport is reflected both in the world championship medals in 2001 and the classifying in the Olympic Games in 2004. This is a reflection of the high investment and hard work of the gymnasts and coaches (De Bosscher et al., 2009; Nunomura & Oliveira, 2012; Bohme; Bastos, 2016).

Although the evolution is clear, there are signs that reveal problems in the organization of the sport in Brazil (Bohme; Bastos, 2016). Restructuring depends on a high investment, however, despite the Agnelo Piva Law, the Athlete Scholarships Program, having benefited some high performance gymnasts, little attention has been directed to the basic training of the Brazilian WAG and the construction of the adequate places for large-scale practice.

Thus, in the same period when the country achieved significant results on the world stage, the number of gymnasts that competed nationally remained low, principally in the adult category (Schiavon, Paes, Toledo & Deutsch, 2013). It is questionable whether this investment is sustainable or if there is a need to improve the Brazilian sports system in order to continue the development of the sport.

There are several factors that have impacted on the WAG participation in the last four Olympic cycles. Thus, we intend to discuss these implications for the evolution of the sport in the country.

The analysis of these cycles and their consequences is essential to direct the sport towards more consistent and sustainable pathways for the development and the future of the next generations of gymnasts in the country.

METHODS

In this study we choose the qualitative approach. According to Triviños (1992), this approach is centered in describing, analyzing, and interpreting the information collected in the investigation and aiming to understanding them in a contextualized way.

The period of analysis includes the Olympic cycles from 2001-2004 to 2013-2016, because this is a milestone for WAG in Brazil. This period reflects a great national evolution in the sport, since Brazil began to participate in Olympic Games with the complete team. This timeframe coincides with the great investment in the Sport, which began after the Sydney Olympic Games.

To achieve the purpose of the study, we collect the data through the records of Olympic competitions. These records have been accessed online on the International Olympic Committee website (https://www.olympic.org/olympic-results), the Olympic Museum (http://www.olympic.org/museum), the International Gymnastics Federation (http: // www .fig-gymnastics.com / site /) and international Gymnastics websites (eg http://www.gymnasticsresults.com/).

Access to the online registers of the Brazilian Gymnastics Confederation (http://www.cbginastica.com.br/) and the Brazilian Olympic Committee (https://www.cob.org.br/en/cob) was the starting point to understand and contextualize the factors that influenced the WAG in Brazil in the specifics Olympic cycles. From the documents found, we searched for references that scientifically supported the results' discussion.

We stand out that the experience of the first author, who participated in the Athens Olympic (2004) as one of the Brazilian Gymnasts and was a coach in one of the most important WAG Clubs in Brazil (2005-2016) was essential to the data analysis and results discussion.

RESULTS AND DISCUSSION

Olympic Cycle 2001-2004: the first participation of a full team

Table 1
WAG's medalists and Brazilian WAG participation in the 2004 Olympic Games.

TEAM	ALL AROUND	VAULT	UNEVEN BARS	BALANCE BEAM	FLOOR EXERCISE
1° ROU (114.283)	1° USA Patterson, C. (38.387)	1° ROU Rosu, M. (9.656)	1° FRA Lepennec, E. (9.687)	1° ROU Ponor, C. (9.787)	1° ROU Ponor, C. (9.75)
2° USA (113.584)	2° RUS Khorkina, S. (38.211)	2° USA Hatch, A. (9.481)	2° USA Humphrey, T. (9.662)	2° USA Patterson, C. (9.775)	2° ROU Sofronie, N. (9.562)
3° RUS (113.235)	3° CHN Zhang, N. (38.049)	3° RUS Pavlova, A.(9.475)	3° USA Kupets, C. (9.637)	3° ROU Eremia, A. (9.7)	3° ESP Moreno, P. (9.487)
	12° BRA Hypolito, D. (36.961)				**5° BRA Santos, D. (9.375)**
	16° BRA Comin, C. (36.074)				

In 2004, the gymnasts established the Brazilian WAG as international contenders, by the unprecedented feat of debuting the Brazilian team at the Olympic Games, although they did not qualify for the team final. From that milestone in the history of the sport, the women's team participated since than in all Olympic Games Editions, including two team finals. The fact is noteworthy for a country that only was represented individually so far.

This was the first cycle in which the establishing of permanent selection took place. The Brazilian gymnasts began to train

in a centralized system in the Center of Excellence in Curitiba and under the command of an experienced technical team from Ukraine with international reputation (COB, 2006; Vieira; Freitas, 2007; Nunomura; Oliveira, 2012). According to De Bosscher et al. (2009), the presence of experienced and internationally renowned coaches contributes to the country's success.

According to the COB (2006), the Training Center provided the athletes and coaches a proper infrastructure, the centralized system promoted the team's integration and a teamwork in pursuit for their objectives.

The achievements and technical evolution of the gymnasts confirmed the Brazilian WAG in the international scenario of the sport, results began to appear gradually, because of the progressive work that was developed and gained more strength and investment (Oliveira, 2010).

With a consolidated work team and adequate and continuous investment, the athletes had the opportunity to participate in international tournaments, events, and internships. All these factors contributed to the performance of the athletes who became well-known to the judges in the international context. De Bosscher et al. (2009) and Bohme & Cunha (2016) stand out that the training infrastructure and the financial support are fundamental aspects for the success in the Sport.

The Olympic team was composed of six athletes: Ana Paula Rodrigues, Camila Comin, Daiane dos Santos, Caroline Molinari, Daniele Hypólito, and Laís Souza. Brazil did not qualify for the team final and finished in 9th place. The difference between Brazil and Australia, which placed 8th, then last in the team final, was 0.074 points. This number corresponds to less than the least penalty/deduction, which 0.10 points.

In the team qualifying competition, five gymnasts competed and the four highest scores were counted. Some faults occurred during the competition and that tiny difference left Brazil out of the team finals.

This was the first cycle in which the final team competition worked in the 6:3:3 system, i.e., the team was composed of six athletes, three of which competed on each apparatus, and all three scores were counted (FIG, 2001).

This change of rules implemented by the International Gymnastics Federation allowed the coach to strategically choose the composition of their team to increase medal chances. This allowed them to invest in the specificity of some athletes.

A specialist gymnast is particularly strong on one or two events, and often competes only on her specific apparatus. It is known that many countries have adopted the strategy of developing specialist gymnasts to boost the results (FloGymnastics, 2016). In addition, this has motivated a greater number of countries and athletes to participate in international events and, therefore, the podium has been shared by different nations.

In the individual all-around competition, Daniele Hypólito and Camila Comin qualified in (12th and 16th place), respectively, and Daiane dos Santos finished in 5th place in the floor exercise final.

When we compare the result of Daniele with that of the Olympic champion, the American Carly Patterson (38,387), there is a difference of 1,426 points. In Artistic Gymnastics, the differences are decimal values, therefore, small values become significant differences. Thus, this difference classified the Brazilian gymnast in 12th place, i.e. there were 10 gymnasts between Hypólito and Patterson.

The scoring system of this cycle allowed more gymnasts to reach the 10.00 points starting value. With this proximity of the starting values, the execution had a decisive role in the gymnasts' qualification. Thus, the factor that differentiated the athletes were the execution faults.

At the beginning of this cycle, at the World Championships in 2001, the gymnast Daniele Hypólito was crowned second place in the floor exercise, while in the Pre-Olympic World Championships in 2003, (qualifier for the Olympic Games) the gymnast Daiane dos Santos became

champion in the same event. These medals are unprecedented for the country.

When analyzing the results of the 2004 Olympic Games, we can conclude that the hegemony of the European Countries and the United States reigned in the WAG. The all-around and individual apparatus medals are concentrated in three countries: Romania, the United States, and Russia.

Despite with this scenario of success in the evolution of the Brazilian WAG, it is important to note that the international results are still inexpressive when considering medals at the Olympic Games and the World Championships (Schiavon, 2009). However, the first medals in world championship were very important to spotlight our WAG in the international events.

Medals are the greatest symbol of results and success in the high performance sport, however, in Artistic Gymnastics creating and naming a new element or combination is also particular to this sport. The gymnasts can baptize new elements if they are the first to perform them in official events and with excellence in the execution (Nunomura, 2008).

In 2001, at the World Championships in Ghent, the gymnast Heine Milani Araújo was the first Brazilian to join the select group of athletes who baptized elements, presenting a forward stretched salto with 2/1 twist dismount on the balance beam.

In 2003, at the Anaheim World Championships, the gymnast Daiane dos Santos performed the double arabian salto piked for the first time and named this element as "Dos Santos". In the 2004 Olympic Games, she presented a stretched variation of Dos Santos and named its second element as Dos Santos II.

Olympic Cycle 2005-2008: the impact of the long-term planning

Table 2
WAG's medalists and Brazilian WAG participation in the 2008 Olympic Games.

TEAM	ALL AROUND	VAULT	UNEVEN BARS	BALANCE BEAM	FLOOR EXERCISE
1° CHN (188.9)	1° RUS Liukin, A. (63.325)	1° PRK Hong, U. (15.65)	1° CHN He, K. (16.725)	1° USA Johnson, S. (16.225)	1° ROU Izbasa, S. (15.65)
2° USA (186.525)	2° USA Johnson, S. (62.725)	2° GER (15.575) Chusovitina, O.	2° RUS Liukin, A. (16.725)	2° RUS Liukin, A. (16.025)	2° USA Johnson, S. (15.5)
3° ROU (181.525)	3° CHN Yang, Y. (62.65)	3° CHN Cheng, F. (15.562)	3° CHN Yang, Y. (16.65)	3° CHN Cheng, F. (15.95)	3° RUS Liukin, A. (15.425)
8° BRA (174.875)	**10° BRA Barbosa, J. (59.55)** **22° BRA Silva, A. (56.875)**	**7° BRA Barbosa, J. (14.487)**			**6° BRA Santos, D. (14.975)**

The Centralized Training and the arrival of renowned foreign coaches were the focus of the Brazilian Gymnastics Confederation and Brazilian Olympic Committee. The objective was to command the Brazilian WAG and improve the country's representativeness in the 2008 Olympic Games. In fact, the results proved to be successful compared to past years, despite the changes in the Code of Points.

Between 2001 and 2005 the WAG scoring system was updated. The extinction of the 10.00 value caused great impact in the training, judging, and public opinion (Kerr; Obel, 2014). Since then, the Artistic Gymnastics is evaluated in an "open code" system, in which there is no longer a limit for the score of the starting value.

In the previous cycle (2001-2004), the maximum score that could be obtained was 10.00, and this score was composed of difficulty value, composition requirements, and additional values that were bonuses for complex combinations and elements with high values of difficulty (FIG, 2001). After reaching the maximum score of 10.00, the

additional elements were no longer counted, but could result in deductions for faults. According to Kerr and Obel (2015) the limit of 10 meant gymnasts who performed greater difficult, and therefore arguably demonstrated a higher level of gymnastics excellence, did not necessarily receive higher scores.

With the "open code" system, scores continued to be composed of difficulty elements, composition requirements, and combination values; however, the maximum score was abolished. According to FIG (2005) this new system provides a more accurate assessment of difficulty and brings more balance to evaluation procedures. As a consequence, the gymnast that presented more difficulty and less deduction, had superior scores.

With this trend, a large number of gymnasts began to present more difficult elements and connected exercises to gain bonuses accordingly (Kerr & Obel, 2015). One of the main contributions of these changes was the improvement of the routines' difficulty level.

Another adjustment in the Code of Points in the period 2001-2005 was the modification of the artistic components value (FIG, 2001). The aim of the International Gymnastics Federation was to foster both perfection in execution and the capacity of artistic expression of the gymnasts. The changes included not only the values for the aesthetical component, but also a new look into the creativity and originality of artistry.

Mastery and excellence in gymnastics are demonstrated by routines with a high level of difficulty and perfection. This new scoring system allowed the champion to be the individual with the highest level of difficulty (performance) and the best technical and artistic execution (Kerr & Obel, 2015).

The balance between the technical difficulty and artistic presentation had always been a challenge in the elaboration of routines, and with the valuing and obligatoriness of the dance elements, jumps and turns became more widely explored by the athletes (Paul, 2010; Cervin, 2015). The International Gymnastics Federation asserts that the new Code of Points provides freedom for the coach and the athlete to elaborate routines, and can invest in both acrobatic and dance elements (FIG, 2017). This freedom expands the possibilities for the various styles and profiles of gymnasts and instigates creativity.

In the 2008 Olympic Games, the effects of the Brazilian team's planning and training under proper conditions became evident. The results obtained were the consequence of a long term perspective, as part and continuity of the work that begun in the previous cycle.

After eight years of the WAG being led by the Ukrainians, Brazilian gymnasts started to present a new technical look, as foreign knowledge was disseminated informally around the country, even though indirectly and informally.

The new gymnasts who arrived at the Training Center in Curitiba benefited from the long-term planning. These athletes received differentiated training from the beginning; the basic elements were perfected to exhaustion, which favored to reach the high performance.

This new generation team benefited from the starting point of the 2004 Brazilian team, with training following the same format line, the centralized system, quality technical and physical infrastructure, and multidisciplinary team, everything to improve the technical and difficulty level of the athletes (Nunomura; Oliveira, 2012).

The Brazilian team, in its second participation, was composed of the veteran gymnasts: Daiane dos Santos, Daniele Hypólito, Laís Souza, and the debut ones: Jade Barbosa, Ana Cláudia Silva, and Ethiene Franco. Brazil got to the final as team, individual all-around, and in the vault and floor events.

The Brazilian team finished in 8th place, below countries with a tradition in Artistic Gymnastics, such as China, the United States, Romania, Russia, Japan, Australia, and France.

The Brazilian WAG presents a small replacement of athletes in the adult category in the international competitions, compared to other countries where the teams are almost completely renewed every Olympic cycle.

The lack of renewal in the Brazilian WAG can be explained in different ways. One of the reasons is that there are only a few places with proper infrastructure and qualified professionals to develop athletes for high performance. Although there are many participants involved in this sport, most children have a small interest and a lack of opportunities to specialize in it (Schiavon et al. 2013).

Without the massification and democratization of the access to the gymnastics discipline, having representativeness in high performance competitions becomes a difficult task. The low number of athletes who achieve high level does not generate competition among the participants of the same group. In addition, the lack of practitioners in Artistic Gymnastics also affects the discovery of new talents.

In more developed countries, like the United States, there are many gyms spread distributed throughout the country and the number of children practicing the sport is much higher than in Brazil (Ryan, 2000; Lima, 2016; USAGYM, 2018). Massification, coupled with excellence training, is an indication of success in the high performance sport (DeBosscher et al. 2009; Bohme; Bastos, 2016).

Brazil still lacks of an overall infrastructure, the competition system with a reduced number of gymnasts seemed to add to this conjuncture. Since the number of gymnasts who reach the highest performance level is very low, and a smaller team means all of them are in the same and highest level as possible, this team became more competitive to compete with other sports powers.

In this cycle, Jade Barbosa was the first Brazilian to win a medal in the individual all-around, and was third in the World Championship in 2007. In the Olympic Games, Jade Barbosa finished in 10th place. The gymnast had two falls, one on the floor and another on the vault, which took her out of the medal race. Jade performed a vault with a high difficulty level, the Amanar, in the expectation of regaining the score, but ended up committing one more fault. In an interview, the gymnast stated that she risked everything in the vault event to try to get a better position on the all around ranking. "A fall is always complicated - I took a risk doing that vault because I had nothing else to lose" (ClicRBS, 2008).

In the vault final, the gymnast didn't perform the Amanar, and opted for a simpler element. However, she had many execution faults, didn't perform a good landing, and finished in seventh position.

Still in these Olympic Games, Daiane dos Santos, finalist on the floor, obtained sixth position. The gymnast disputed the medal, but stepped twice outside the boundary on her floor routine, she was penalized and did not make the podium.

During these eight years with coach Ostapenko in charge, the Brazilian WAG team had its best period; it managed to enter the international scenario of the sport and introduced Brazil into the elite sporting group.

Olympic Cycle 2009-2012: a period of transitions

With the closing of a cycle of success and significant results for the Artistic Gymnastics in Brazil, the cycle of 2009-2012 began with many organizational changes.

After 18 years in the command of the Brazilian Gymnastics Confederation, the then president, Vicélia Florenzano, handed over her position to her deputy, Luciene Resende, for the next years, and Brazilian Gymnastics Confederation's headquarters moved from Curitiba to Aracaju (Folha de Londrina, 2009).

The coach Oleg Ostapenko's contract ended, he returned to Ukraine and took over the local Artistic Gymnastics team. Thus, coach Iryna Illyashenko, who until then had

assisted Oleg, assumed the position of head coach (Globoesporte, 2009).

Table 3
WAG's medalists and Brazilian WAG participation in the 2012 Olympic Games.

TEAM	ALL AROUND	VAULT	UNEVEN BARS	BALANCE BEAM	FLOOR EXERCISE
1° USA (183.956)	1° RUS Komova, V. (60.632)	1° ROU Izbasa, S. (15.191)	1° RUS Mustafina, A. (16.133)	1° CHN Deng, L. (15.6)	1° USA Raisman, A. (15.6)
2° RUS (178.53)	2° USA Raisman, A. (60.391)	2° USA Maroney, M. (15.083)	2° CHN He, K. (15.933)	2° CHN Sui, L. (15.5)	2° ROU Ponor, C. (15.2)
3° ROU (176.414)	3° USA Douglas, G. (60.265)	3° RUS Paseka, M. (15.05)	3° GBR Tweddle, E. (15.916)	3° USA Raisman, A. (15.066)	3° RUS Mustafina, A. (14.9)
	36° BRA Leal, B. (52.765)				
	37° BRA Hypolito, D. (52.732)				

The Training Center in Curitiba was maintained, but not the centralized training regime. Criticism from clubs and coaches abound; medical scandals and the high costs for the maintenance of the gymnasts in this centralized system pushed the changes to be implemented.

In this way, each gymnast from the national team began to train in their respective clubs. The centralized training began to take place sporadically, mainly in periods prior to competitions, as a short-term centralized system (IG, 2011).

Currently, some countries continue to invest in the intensive centralized system, while others opt for centralized preparation in short periods, as is the case in Brazil and the United States.

Studies show that the centralized preparation system in Brazil brought visibility to the sport and more expressive results in the international scenario. Nunomura and Oliveira (2012) state that "during this period the best results in the history of Brazilian WAG were achieved".

However, centralization contained unfavorable aspects, as benefitting a minority group, and destabilizing the home clubs of the gymnasts, as their best athletes spent more time in the training center than in their own clubs (Nunomura & Oliveira, 2012).

During this long period, the centralized training system weakened the support in clubs. Nunomura and Oliveira (2012) interviewed coaches who stated that "this fact discouraged several gymnasts who were not selected, a fact that contributed to the decreasing number of gymnasts training in the country in that period".

With these effects stemming from the long period of centralized training, the number of gymnasts with the age and technical level to join the preparatory team for the 2012 Olympic Games was very low. Thus, Brazil was represented in the Olympic Games by 3 experienced gymnasts and two new team members.

The decentralization of training did not allow all athletes to remain focused and with common objectives. The clubs did not have the same infrastructure and thus, the decreasing in the athletes' performance was clear.

In addition, the Brazilian team had several problems in the selection of athletes before the Olympic Games. Gymnast Jade Barbosa had contractual problems with the Brazilian Gymnastics Confederation and was not selected to join the team. Laís Souza and Adrian Gomes were injured and cut off the team. Furthermore, the uncertainty surrounding the participation of Daiane dos Santos, who in 2010 was suspended for 5 months by the International Gymnastics Federation, for being caught in the anti-doping exam, widened the problem.

Thus, Ethiene Franco and Harumy Freitas were selected to join the Brazilian team along with Daniele Hypólito, Daiane dos Santos, and Bruna Leal.

In that year, Brazil did not qualify for any finals; its participation was the least significant since the country began to compete with a full team in the Olympic Games.

This team had its peak in the Test Event in January 2012, when they were guaranteed the team place in the Olympic Games only in the repechage. During participation in these Olympic Games, the Brazilian WAG did not perform well, as they presented several technical faults.

Despite the decreasing in performance in this edition of the Olympic Games , the Brazilian WAG was again represented by a full team, while countries with a tradition in the sport such as Spain and Ukraine, were represented only by individual gymnasts.

This cycle ended with the hope that a new generation of gymnasts was being prepared to represent the country in the following international events.

Olympic Cycle 2013-2016: competition at "home"

Table 4
WAG's medalists and Brazilian WAG participation in the 2016 Olympic Games.

TEAM	ALL AROUND	VAULT	UNEVEN BARS	BALANCE BEAM	FLOOR EXERCISE
1° USA (184.897)	1° USA Biles, S. (62.198)	1° USA Biles, S. (15.966)	1° RUS Mustafina, A. (15.9)	1° NED Wevers, S. (15.466)	1° USA Biles, S. (15.966)
2° RUS (176.688)	2° USA Raisman, A. (60.098)	2° RUS Paseka, M. (15.253)	2° USA Kocian, M. (15.833)	2° USA Hernandez, L. (15.333)	2° USA Raisman, A. (15.5)
3° CHN (176.003)	3° RUS Mustafina, A. (58.665)	3° SUI (15.216) Steingruber, G.	3° GER Scheder, S. (15.566)	3° USA Biles, S. (14.733)	3° GBR Tinkler, A. (14.933)
8° BRA (172.087)	**11° BRA Andrade, R. (56.965)** **24° BRA Barbosa, J. (NO SCORE)**			**5° BRA Saraiva, F. (14.533)**	

Rio de Janeiro was chosen to host the 2016 Olympic Games, a fact that encouraged the Brazilian Olympic Committee and Ministry of Sport to invest great amount of money to maximize the country's success.

Among the initiatives of the Ministry of Sport we quote the Brazil medal plan. The objective of the one billion reais investment was to place Brazil among the top 10 in the general ranking of the Olympic Games.

The distribution of the investment considered the higher chances of the sport winning medals. Thus, among 21 Olympic sports, Artistic Gymnastics was identified as one of them.

This initiative provided support to athletes, such as the podium scholarship (new category of athletic scholarship), in addition to funding for multidisciplinary teams, acquisition of training equipment, and costs regarding training and competitions inside and outside Brazil.

In the WAG, the Russian Alexander Alexandrov was hired as the new head coach of the Brazilian team and a Training Center was built in Rio de Janeiro. Alexandrov commanded the Russian artistic gymnastic for many years and in his last achievement as the coach of the Russian team, he won five medals in the Olympic Games 2012 (ESTADÃO, 2015).

With the arrival of Alexandrov, investment in the sport was on the rise and Brazil was able to once again leverage WAG results.

The first initiative to structure this cycle was the organization of a training camp, held in Três Rios, which brought together 23 gymnasts, 8 Brazilian and 5 foreign coaches, and 8 judges.

According to the gymnastics squad coordinator, Georgete Vidor, the initial objective was to join all the athletes of the country, who were of age to compose the Brazilian national team and compete in the

Olympic Games. Subsequent to this camp, the coach Alexandrov traveled to Brazil and accompanied the development of the athletes. This entire process was aimed at evaluating the performance of the gymnasts and selecting those who would compose the Brazilian team and prepare for the Olympic Games in Rio de Janeiro.

With the team already established, a Training Center was built in Rio de Janeiro that offered all the infrastructure, multidisciplinary team for the development of the athletes.

The Brazilian team training remained in the centralized format in short periods; the training meetings were frequent and took place in both the Training Center in Rio de Janeiro and in Curitiba. In addition, many training competitions abroad were planned to assist in preparing athletes and maintaining the team integrated.

The majority of the athletes from the group in this cycle were from the states of Rio de Janeiro and Paraná. Thus, the athletes who already lived in Rio de Janeiro, started to train in the Training Center in Rio, and the athletes from Paraná continued training in their club, i.e., in the Training Center in Curitiba, which had already been established in the previous cycles. The team that represented Brazil in this edition of the Olympic Games was composed of two veterans, Daniele Hypólito and Jade Barbosa, and three debuts, Lorrane Oliveira, Flávia Saraiva, and Rebeca Andrade.

This composition mixed the experience of the older athletes with the liveliness of the new members of the team and it was successful, as the Brazilian team returned to qualify for the team final, equaling the success in Beijing and finishing the competition in 8th place (Brazilian Gymnastics Federation [CBG], 2017).

Furthermore, we should point out that the gymnast Rebeca Andrade finished the all-around individual competition in 11th place, totaling 56.965. There was an expectation of a higher position, as the gymnast ranked 4th and totaling 58.732, behind three American gymnasts, Biles (62.366), Raisman (60.607), and Douglas (60.131), an unheard fact in Brazil.

It was the first time that Brazil had qualified for an Olympic final among the top positions. On previous Olympic Games the best result was achieved by Jade in 2008, when she qualified to the final in the 12th position. The expectation of an Olympic medal over Rebeca was quite huge.

As the rule for the all-around individual and team final participation allows only two gymnasts per country, Rebeca automatically moved up to 3rd place. In the individual all-around final, the gymnast had some faults on the balance beam, which generated a sum of points lower than the qualifying competition.

The gold in the individual all-around went to the American Simone Biles with 62.198, the silver also to an American, Alexandra Raisman with 60.098, and the bronze to the Russian Alyia Mustafina who scored 58.665.

Flávia Saraiva also scored the unbeaten record of qualifying for the final on the balance beam in 3rd place with 15.133. Thus, the chances of a medal were real, as Flávia had a starting value high enough to dispute the podium. However, in the final she had some faults that lowered her score to 14.533, or 0.600 lower than the qualifying phase and she finished the competition in 5th place.

The gold went to the Dutch gymnast Sanne Wevers (15.466) and the silver and bronze to the American gymnasts, Laurie Hernandez (15.333), and Simone Biles (14.733), respectively.

Although the athletes had gone through a long period of technical and psychological preparation, the pressure for results added to their immaturity and inexperience in large competitions could have contributed to these technical faults in the finals.

We emphasize that the most expressive results obtained in this cycle were won by young athletes, still young and qualified, and although the Olympic medal did not come true, there is still the potential in the future results of the Brazilian WAG.

CONCLUSION

It is a challenging task to analyze the performance of the Brazilian WAG in the last four Olympic cycles, as multiple factors influenced the results and it is necessary to reflect on the contribution and consequences for this sport.

In this way, we believe that the main contribution of our study is the compilation of the experience obtained with this unique period for the WAG and how it could be used for the development of the future generations of gymnasts.

Thus, we highlight that the development of Brazil in the Olympic Games is not restricted only to the last four cycles analyzed in the present study. Previous generations were essential for the development of the current WAG, since they started this process, although they did not have similar training conditions and investment.

Claudia Magalhães, Tatiana Figueiredo, and Luisa Parente were the first gymnasts to represent the country in the Olympic Games and demarcate our history, since they were the first to take the name of the Brazilian WAG to the Olympic level. Schiavon (2009) denominated them "pioneer gymnasts", as in their time the sport did not present the current organization or investment.

Soraya Carvalho, Daniele Hypólito, and Camila Comin also competed individually represented the country in Olympic Games. According to Schiavon (2009), "these gymnasts faced similar difficulties as their predecessors. On the other hand, they also took part in an important transitional period, when structural conditions began to improve and came to the 1st participation of the WAG team in the Olympic Games.

We identified that the restructuring of the Brazilian WAG since 2000 was decisive for it to reach the current level. The improvement of the training and competition conditions, the structuring of a Training Center of excellence, the support of the multidisciplinary team, and the guidance of the renowned foreign coaches was essential for the preparation of the gymnasts that composed the Brazilian teams in the Olympic Games.

The "long-term" philosophy of the coaching reflected in the qualifying of the Brazilian team for the team final in the Olympic Games in 2008. For the Brazilian WAG, which in that year participated only for the eighth time in the Olympic Games and for the second time qualified with a full team, the fact of being among the top eight ranking is a result that deserves much celebration.

In the following cycle, i.e., 2009-2012, we identified some problems; the end of the Training Center coincided with a series of organizational changes. The Brazilian team obtained the classification for the Olympic Games only in the second chance, and its performance was not compatible with previous expectations.

In 2016, with the Rio de Janeiro Olympic Games, investment in Artistic Gymnastics returned. In spite of the uncertainty generated by the non-classification for the Olympic Games in the pre-Olympic world championship, in the event test the gymnasts won the right to compete. In the Olympic Games, they qualified for the team final again, in addition to the beam final with Flávia Saraiva and the 11th place for Rebeca Andrade in the individual all-around.

We realize that Brazilian WAG has stabilized its representation with a full team in the Olympic Games. From the 2004 Olympic Games to the latest edition, the country has retained the team's classification. Even though WAG has gone through phases of instability, the work has been maintained and the results are in progress.

Back to the 16 years of our WAG history we can say that the considerable investment was essential for the evolution of the WAG. However, we question whether there is a legacy of this Training Center existing period and whether this investment would be sustainable.

Supporting financially the lives of gymnasts, maintaining a well-equipped gymnasium, and paying the salaries of a multidisciplinary technical team is costly, and when we look at the Training Center legacy we note that despite positive results in 2004 and 2008, there was little renewal in the group and the number of international-level gymnasts competing in the country remained low.

The objectives until 2008 were achieved, the WAG was raised to an international level and received greater recognition. Wonder the value of directing the investments to a small and non-renewed group, instead of promoting the practice of Artistic Gymnastics on a wider scale.

Furthermore, when analyzing the table of results and the discussions presented, we can see that there is no definition of a Gymnastics school in our country. And, with the arrival of foreigners, the training school model established was Russian and Ukrainian, with some adaptations necessary for our reality. As we do not have this school defined, nor a high number of athletes who achieve the high performance, coaches invest and take advantage of the qualities and natural gifts of each gymnast, so they seek the best potential that each athlete has.

Countries with greater tradition in this sport that have an established Artistic Gymnastics school can be observed. China, for example, is characterized by lightweight, graceful, high technical level on the beam and uneven bars apparatus and risky acrobatics approach. On the other hand, the American school presents a high number of athletes and homogeneity in the technical level of the team, and invests in physical strength and power.

Brazil has always been a great competitor in the apparatuses that demand strength and power, the results presented reveal the expressiveness in the floor and vault. The Brazilian women were Olympic finalists on the floor in 2004 and 2008 and in the vault in 2008.

On the other hand, Brazil has never qualified for the uneven bars or balance beam. The first has always been considered a weak point of the country, although the technical level and performance of the Brazilian WAG increased significantly on this apparatus along the cycles analyzed. The gymnasts became finalists in World Cups and other international events, including the team final of the 2016 Olympic Games, when the team score on the uneven bars was the second highest among the four apparatus exercises.

The unprecedented balance beam final of the gymnast Flávia Saraiva, in the 2016 Olympic Games, added to this picture, and justified the technical investment in the specialty of each athlete and the improvement in the technical level on apparatus that were not previously disputed by Brazilian WAG.

In fact, the evolution of the Brazilian WAG is notorious, particularly in the last four Olympic cycles. However, facing the organizational gaps in the Brazilian sports system and the sport in question, we believe that long-term athlete development system and investment seem to follow the immediacy logic of high performance sport in the country.

We believe that a long-term athlete development, with particular emphasis on the formative stages, could improve the future perspectives of our WAG. In turn, this could enhance the number of potential gymnasts entering the higher levels of the sport.

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TRAMPOLINE GYMNASTICS: THE BRAZILIAN PARTICIPATION AT INTERNATIONAL CHAMPIONSHIPS – THE OLYMPIC GAMES STILL A DREAM

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Original article

Abstract

Since the modern trampoline was built by George Nissen and Larry Griswold around, 1934 in USA, this equipment and its use has suffered drastic changes. Its development was decisive in order to Trampoline Gymnastics to be included at the Olympic Games program in 2000. In Brazil its practice started in the 1980's, and has been only integrated the Brazilian Gymnastics Federation in 1999. The purpose of the study is to analyze the Brazilian participation in the international trampoline gymnastics championships. Data collection was performed by the documental and bibliographic research of main international trampoline gymnastics competitions. The results show that, even though Brazil is the leader in South America with relevant participation in the continental level, the first participation at an Olympic Games had only been possible in 2016, because Brazil was the host country. We conclude that the Brazilian participation in World Championships and in the Olympic Games is not relevant. Finally, the lack of adequate equipment, the bad condition of the training centers, the absence of regular and official coaching education programs and the lack of support for the clubs, shows that this gymnastics discipline is not a current priority for the National Sports authorities, hindering its development internally.

Key words: *Gymnastics; Olympic Games; Competition; Sport development.*

INTRODUCTION

Since Trampoline Gymnastics (TG) was included into the Summer Olympic Games (OG) program in 2000, with the trampoline individual competition (Men and Women), we had noted that this discipline has been attracting more attention from sports authorities, media and also sport science researches (Walker, 2000).

The Brazilian development on TG started in the second half of 1970, after the income of German Professor Dr. Hartmut Riehle in 1974. Some Artistic Gymnastics' (AG) coaches, as Mr. José Martins Oliveira Filho, became really interested in TG, subsequently attending to foreign courses and lecturing courses in Brazil (Brochado & Brochado, 2005).

In 1976, it was organized the first double mini-trampoline championship in Sports Gymnastics Club of Rio de Janeiro, by the initiative of Mr. Sergio Bastos, who was an ex-AG gymnast and one of the main specialists of TG in Brazil (Roveri, Carrara, & Bortoleto, 2017). In 1984, the achievement of Intercity Tournament of São Paulo State was considered a landmark to the consolidation of TG in Brazil, although there were only three teams from three cities present. Two years later, in 1986, the first TG interstate championship happened with competitors from the States of Rio de Janeiro and São Paulo.

The first official organizational and administrative entities of this discipline in Brazil are the *São Paulo* Federation of Acrobatic Trampoline (PFAT), founded officially on May 12, 1990, but active since 1989; and the Brazilian Confederation of Trampoline and Acrobatics Sports (BCTAS), head office in Rio de Janeiro, founded officially on November1st 1995, but active since 1990. Highlighted as the first president of PFAT and BCTAS, as well as the precursor of this discipline in Brazil, is Mr. José Martins Oliveira Filho (Bernadeli, 1998).

In 1989, it was created the first Trampoline State Federation in São Paulo. The participation of a group of Brazilian coaches and gymnasts from São Paulo and Rio de Janeiro states, leaded by José Martins in a course held in Konstanz (Germany), was fundamental. In the same year, it was founded in Rio de Janeiro, the Federation of Trampoline and Acrobatic Gymnastics, being Mr. Bastos elected its president.

Therefore, trampoline started to be developed as a competitive sport in Brazil. In September of 1990 occurred the first national championship in São Paulo. During the event, it was founded the Brazilian Association of Trampoline (Brochado & Brochado, 2005), that has become affiliated to Fédération *Internationale de Trampoline* (FIT) in the same year, projecting Brazilian TG into an international scenario. The first president elected was Mr. José Martins with Mr. Christiano Andrade as vice-president (Roveri, Carrara, & Bortoleto, 2017).

Finally, in 1999, after the fusion of FIT to FIG, the BCTAS was incorporated to BGC, changing substantially the institutional and administrative model of this discipline in Brazil

In Brazil, while this discipline development has started in the 1980´s, its inclusion in OG was not enough to significantly modify its development, as it has happened in other countries (Roveri, Carrara, & Bortoleto, 2017), even though Brazil is the leader country in this discipline in South America.

Therefore, the purpose of this paper is to analyze the Brazilian gymnasts' participation in the main international TG competitions (Pan-American games, World Games, World championships and OG), information that may be helpful to understand the challenges faced to its development in Brazil and other developing countries. In this sense we also believe the following analysis may bring a panorama of the Brazilian TG development in the international scenario.

METHODS

This is an exploratory descriptive study based on bibliography and documentation reviews (Denzin & Lincoln, 1994). The qualitative research was adopted to analyze a particular situation, helping to describe the complexity of an issue and map the interaction among various parts composing it. Individual and team finalists and medalists were searched within competitions results.

Data collection to this research was performed by the documental and bibliographic research (Marconi & Lakatos, 2010). The documental research aims to select documents that did not suffer any scientific treatment (Godoy, 1995). In this case, we have selected documents strictly related to TG, as competitions results, mainly from *Fédération Internationale de Gymnastique* (FIG), *Union Europeenne de Gymnastique* (UEG), USA Gymnastics

(USAGYM), Gymnastics Canada (GYMCAN) and also at Brazilian Gymnastics Confederation (BGC) web pages, as well as other documents (newsletters, magazines) (Figure 1 and 2) donated by Mr. Bastos, one of principal TG expert in Brazil, to the Physical Education Faculty of University of Campinas. We have considered the Brazilian results from 1999 to 2017 in all Pan-American Games (PG), Olympic Games (OG), World Championship (WC), World Age Group Competition (WAGC) and World Games (WG) editions.

On the other hand, the bibliographic research had the aim to gather and organize specialized publications (books, master and PhD dissertation and scientific articles) (Marconi & Lakatos, 2010).

The data found was systematized in different worksheets using Excel (Microsoft Office, 2013) being analyzed from two main categories: competition level (PG; OG; WC; WAGC and WG) and gymnasts' gender (men's and women's). The criterion adopted to finish the data collection was the "saturation" as indicated by (Denzin & Lincoln, 1994; Saunders et al, 2018).

This research was submitted to the Research Ethics Committee of Faculty of Medical Sciences of University of Campinas (UNICAMP), being approved under the decision number: 989,213.

Figure 1. (Left) Newsletter from Brazilian Federation of Trampoline and Acrobatic Sports (BFTAS) – Year 1 – nº 1. Source: Sergio Bastos personal collection.
Figure 2. (Right) Newsletter from BFTAS – Year 2 – nº 3. Source: Sergio Bastos personal collection.

RESULTS AND DISCUSSION

Competitive Results in Pan-American Games

The Pan-American Games (PG) is considered the main continental competition, being held every four years with the participation of gymnasts from North, Central and South America. Organized by the Pan American Sports Organization (PASO), the PG structurally resemble to Olympic Games, covering sports that take part to this competition and also some other disciplines. The TG debuted in PG in Mexico City in 1955 as a "sub-discipline" of AG. After the edition of

Chicago in 1959, TG was withdrawn from the program (USAGYM, 2017). The return of TG in PG should have occurred in Santo Domingo (Dominican Republic) in 2003; however, due to the reduced number of gymnasts registered, it was postponed to Rio de Janeiro edition in 2007. The trampoline medal winners of PG were:

Table 1
Medalists in Pan-American Games Edition.

Pan-American Games Edition	Men	Women
2015 Toronto, Canada	1. Keegan Soehn, CAN 2. Steven Gluckstein, USA 3. Angel Hernandez, COL	1. Rosannagh Maclennan, CAN 2. Dafne Navarro Loza, MEX 3. Karen Cockburn, CAN
2011 Guadalajara, Mexico	1. Keegan Soehn, CAN 2. *Rafael Andrade, BRA* 3. Jose Vargas, MEX	1. Rosannagh Maclennan, CAN 2. Dakota Earnest, USA 3. Alaina Williams, USA
2007 Rio de Janeiro, Brazil	1. Chris Estrada, USA 2. Jason Burnett, CAN 3. Ryan Weston, USA	1. Karen Cockburn, CAN 2. Rosanna MacLennan, CAN *3. Giovanna Matheus, BRA*
1959 Chicago, USA	1. Ronald Munn, USA 2. Harold Holmes, USA 3. Abie Grossfeld, USA	-
1955 Mexico City, Mexico	1. Donald Harper, USA 2. William Roy, USA 3. E. Fereda, VEN	-

Legend: BRA=Brazil, CAN=Canada, COL=Colombia, MEX=Mexico, USA=United States of America, VEN=Venezuela. Source: Adapted from USAGYM (2017) and WikiVisually (2017).

It is possible to note that Brazil has won two medals in PG competition, one bronze by Giovanna Matheus in 2007 (Figure 3) and one silver by Rafael Andrade in 2011(Figure 4). Brazil places 3rd in general qualification over all PG editions, tied with Mexico (2 medals) and behind the continental powers Canada (8 medals) and USA (10 medals). Although it is more highlighted than other South American countries, Brazilian participation is still less successful than North American countries.

Figure 3. (Left) Giovanna Matheus in Rio-BRA/2007. Credits: EFE.
Figure 4. (Right) Rafael Andrade in Guadalajara-MEX/2011. Credits: Photo&Grafia.

Table 2
World Championships in FIT era (1964 – 1998).

Year	City, Country	Number of National Federations	Event
1964	London, GBR	12	1st WC
1965	London, GBR	12	2nd WC
1966	Lafayette, USA	8	3rd WC
1967	London, GBR	9	4th WC
1968	Amersfoort, NED	9	5th WC
1970	Bern, SUI	11	6th WC
1972	Stuttgart, GER	11	7th WC
1974	Johannesburg, RSA	11	8th WC
1976	Tulsa, USA	11	9th WC
1978	Newcastle, GBR	10	10th WC
1980	Brig, SUI	15 + 2	11th WC
1982	Bozeman, USA	14	12th WC
1984	Osaka, JPN	18	13th WC
1986	Paris, FRA	20	14th WC
1988	Birmingham, USA	22	15th WC
1990	Essen, GER	23	16th WC
1992	Auckland, NZL	25	17th WC
1994	Porto, POR	26	18th WC
1996	Vancouver, CAN	30	19th WC
1998	Sydney, AUS	29	20th WC

Legend: World Championship = WC. Source: Adapted from FIG (2017b).

Participation in World Championships

Considered the most important TG competition in international context, the World Championship (WC) is competed in four events: Individual Trampoline (TRI), Synchronized Trampoline (TRS), Double-Mini-Trampoline (DMT) and Tumbling (TUM) (FIG, 2017a). Between 1964 and 1998 the WC was carried out under FIT responsibility, on the following cities (table 2).

From 1999 on, the WC of TG were directed by FIG (FIG, 2017d). The WC are depicted below according to year, local, number of participant federations, event edition and results of Brazilian gymnasts, that were qualified to the finals; and highlighting Rafael Andrade, who was qualified to 2016 OG in Rio de Janeiro.

Table 3
World Championships in FIG era (1999 – 2017).

Year	City, Country	N.F.	Event	Brazilian's Results
1999	Sun City, RSA	35	21st WC	3rd Rodolfo Rangel, DMT M
2001	Odense DEN	35	22nd WC	3rd Rodolfo Rangel, DMT M
2003	Hannover, GER	41	23rd WC	5th Gabriel Miranda, DMT M
2005	Eindhoven, NED	37	24th WC	47th *Rafael Andrade,* TRI M
2007	Quebec, CAN	31	25th WC	8th Samantha Oliveira, DMT W 47th *Rafael Andrade,* TRI M
2009	St. Petersburg, RUS	31	26th WC	4th Bruno Martini, DMT M 4th Team: Barbara Silva, Renata Teles, Virginia Lins, Samantha Oliveira, DMT W 68th *Rafael Andrade,* TRI M
2010	Metz, FRA	32	27th WC	62nd *Rafael Andrade,* TRI M
2011	Birmingham, GBR	35	28th WC	1st Bruno Martini, DMT M 2nd Team: Arthur Iotte, Bruno Martini, Edmon de Abreu, Rodrigo Bachur, DMT M 58th *Rafael Andrade,* TRI M
2013	Sofia, BUL	39	29th WC	8th Mariana Aquino, DMT W 8th Bruno Martini, DMT M 38th *Rafael Andrade,* TRI M
2014	Daytona Beach, USA	41	30th WC	88th *Rafael Andrade,* TRI M
2015	Odense, DEN	40	31st WC	36th *Rafael Andrade,* TRI M
2017	Sofia, BUL	34	32nd WC	55th *Rafael Andrade,* TRI M

Legend: N.F. =National Federation; TRI= Trampoline individual; TRS= Trampoline Synchronized; DMT= Double-mini Trampoline; TUM= Tumbling; W= Women; M= Men. Source: FIG (2017b), GYMCAN (2017), and UEG (2017).

Firstly, it is worth to indicate that it was in 1990 the first Brazilian participation in WC, by the gymnast Christiano Andrade and his coach José Martins, and since then present in all events of FIT era, WC and WAGC (Bernadeli, 1998), as well as in FIG era. Over all history of WC, we were not able to see a Brazilian gymnast achieving qualification to finals of TRI, TRS or TUM. The best Brazilian result in FIG era was in 2005, as the 20th place of Anna Paula Milazzo on TRI; 10th place of Anna Paula Milazzo and Anna Carolina Milazzo on TRS. Giovanna Venetiglio Matheus, on the 26th place of WC Birmingham/2011, was classified to the Test Event, held in January of 2012 in the host city of the Olympic Games in London, reaching the 13th place (1st reserve) (FIG, 2017d). The four medals achieved in a WC in FIG era were all on DMT, in men scenario we can see in Birmingham/2011 Bruno Martini individual champion and team vice-champion; Rodolfo Rangel, 3rd place in 1999 and 2001 (Figure 5).

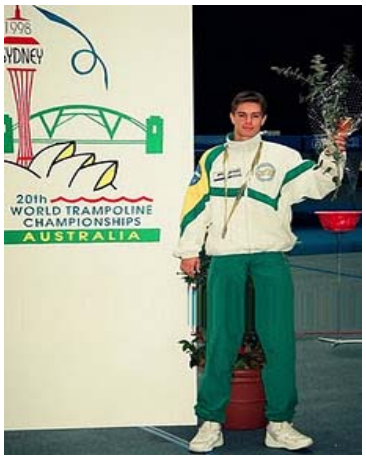

Figure 5. Rodolfo Rangel, DMT World Champion in Australia/1998. Source**:** TrampBrasil (2011).

On the other hand, we point out that no edition was held in Brazil neither in other South America countries, a fact that disclosed low representativeness of these countries in this discipline. The expenses are too high and the countries cannot afford international events (Arantes, 2015).

Consequently, Brazilian delegations participating traditionally in WC had financial difficulties to afford high cost, typical of intercontinental trips, a condition that has been only improved recently but only to a few gymnasts of senior national teams of TRI, after it has been included in OG program, so then started to receive financial support from Brazilian Olympic Committee and from BGC sponsors (Roveri, Carrara, & Bortoleto, 2017).

We also point out that since the decade of 1980, the number of national federations presenting at WC has risen significantly, reaching the number of 40 in the last edition. Probably this increases the competitiveness and consequently has impact at the Brazilian participation in order to achieve good results. The DMT Brazilian team, 2nd place in WC 2011, is until this moment the only national team, of all gymnastics disciplines represented by BGC, to reach a medal in WC (Figure 6).

Figure 6. Brazilian Team Vice-World champion on DMT in Birmingham, 2011. Highlight to Bruno Martini (left side of photo) Individual World Champion in DMT in the same competition. Source: FIG (2017b).

Brazilian participation in the World Age Group Competitions

The World Age Group Competition (WAGC) 1st edition occurred in 1973 in London; in 2017 this event reached its 25th edition (FIG, 2017b). It is held in the same place as the WC, generally on the week after, it[s goal is to promote the events that exists in the discipline, aiming to raise the number of participants at World level and stimulate young gymnasts to reach the elite level. Notwithstanding, in the Brazilian case the expenses related to competition participation is a participant responsibility, a fact that unable the participation of many gymnasts, not to say the majority.

The participation of Brazilian gymnasts in WAGC is defined by the results obtained on Brazilian Age Group Competition (BAGC), with a similar competition format, specifically, in categories of 11-12 years, 13-14 years, 15-16 years and 17-21 years (FIG, 2017a). In BAGC there are also categories of 9-10 years and senior category over 21 years (CBG, 2017).

Analyzing the WAGC organized by FIG, since 1999, we can verify that some Brazilian gymnasts achieved medals (table 4 and table 5), showing that in some events the youngest gymnasts have developed an international level. In the referred tables it was included only finalists in the respective events and competitive categories in WAGC.

Table 4
Results on World Age Group Competition in FIG era 1999 – 2009.

Year	City, Country Event	Brazilian's Results
1999	Sun City, RSA 14th WAG	6th Anna Paula Milazzo, TRI 11/12 W 3rd Bruno Martini, DMT 11/12 M 2nd Anna Paula Milazzo, DMT 11/12 W 5th Carlos Ramirez Pala, DMT 13/14 M 3rd Mariane Ferreira, DMT 15/16 W 4th Anna Carolina Milazzo, DMT 15/16 W 1st Bruno Martini, TUM 11/12 M
2001	Odense, DEN 15th WAG	3rd Anna Paula Milazzo TRI 13/14 W 6th Carlos Ramirez Pala, TRI 15/16 M 1st Anna Paula Milazzo DMT 13/14 W 4th Thiago Cardoso, DMT 13/14 M 5th Bruno Martini, DMT 13/14 M 3rd Gabriel Miranda, DMT 17+ M
2003	Hannover, GER 16th WAG	3rd Ana Paula Teixeira/Rebeca Cruz, TRS 17+ W 2nd Ingrid Alves, DMT 11/12 W 3rd Renata Teles, DMT 13/14 W 4th Bárbara Silva, DMT 13/14 W 1st Anna Paula Milazzo, DMT 15/16 W 2nd Bruno Martini, DMT 15/16 M 6th Claudio Silva, DMT 15/16 M 6th Deborah Costa, DMT 17+ W 3rd Rafael Andrade, DMT 17+ M 4th Bruno Martini, TUM 15/16 M

2005	Eindhoven, NED 17th WAG	6th Clara Porreca / Daienne Lima, TRS 11/12 W 1st Bruna Carambone / Giovanna Bastos, TRS 15/16 W 1st Samantha Oliveira, DMT 17/18 W
2007	Quebec, CAN 18th WAG	6th Vanessa dos Santos / Joana Perez, TRS 17/18 W
2009	St. Petersburg, RUS 19th WAG	6th Daienne Lima, TRI 15/16 W 2nd Rodrigo Pacheco, TRI 17/18 M 7th Larissa Aladim, DMT 11/12 W 1st Clara Porreca / Daienne Lima, TRS 15/16 W 8th Daniela Petti / Fernanda Amaral, TRS 17/18 W

(Legend: TRI= Trampoline individual; TRS= Trampoline Synchronized; DMT= Double Mini Trampoline; TUM= Tumbling; W= Women; M= Men). Source: Adapted from FIG (2017d), GYMCAN (2017) and USAGYM (2017).

Table 5
Results on World Age Group Competition in FIG era 2010 – 2017.

Year	**City, Country Event**	**Brazilian's Results**
2010	Metz, FRA 20th WAG	3rd Alice Gomes, DMT 11/12 W 6th Leonardo Chaves Vieira, DMT 11/12 M 5th Mariana Aquino, DMT 17/18 W
2011	Birmingham, GBR 21st WAG	5th Carolina Aladim, TRI 17/18 W 7th Camilla Gomes / Marcela Martins, TRS 17/18 W 5th Alice Gomes, DMT 11/12 W 6th Leonardo Chaves Vieira, DMT 11/12 M 1st Alexandre Lucas Silva, DMT 13/14 M 2nd Breno de Paula Souza, DMT 13/14 M 2nd Carolina Aladim, DMT 17/18 W 6th Andressa Ferreira Sandes, DMT 17/18 W
2013	Sofia, BUL 22nd WAG	8th João Dorim / Vitor Ferreira Camargo TRS 11/12 M 4th Vitor Ferreira Camargo DMT 11/12 M 6th Lorrane Souza Sampaio DMT 13/14 W
2014	Daytona Beach, USA 23rd WAG	8th Rayan Dutra, TRI 11/12 M 4th Iago Gomes / Davi De Souza TRS 11/12 M 8th Lorrane Sampaio / Maria Rodrigues, TRS 13/14 W 6th Pedro Moura / Rayan Dutra, TRS 13/14 M 7th Milena Soares Matias, DMT 13/14 W 8th Rafael Dias da Cunha, DMT 13/14 M 3rd Lucas Henrique Sotero, TUM 15/16 M

2015	Odense, DEN 24 WAG	4th Davi Souza / Pedro Moura, TRS 13/14 M 8th Iago Gomes / João Dorim, TRS 13/14 M 7th Maria Rodrigues / Luara Rezende, TRS 15/16 W 7th Alice Gomes / Larissa Aladim, TRS 17/18 W 3rd Lorrane Souza Sampaio, DMT 15/16 W
2017	Sofia, BUL 25th WAG	1st Lucas Tobias, DMT 17/21 M

Legend: N.F. = National Federation; TRI= Trampoline individual; TRS= Trampoline Synchronized; DMT= Double Mini Trampoline; TUM= Tumbling; W= Women; M= Men Source: Adapted from FIG (2017d) and USAGYM (2017).

Figure 7. Lucas Tobias, DMT Gold medalist at WAGC/2017. Source: Lance! (2017).

The WAGC is the event with the highest participation of Brazilian gymnasts, because of the number of age ranges. In 2017, there were 19 gymnasts in WAGC and 6 in WC (FIG, 2017d). The positive results in WAGC were obtained in different events of TG, with predominance of medals in DMT (17) (Figure 7), over TRS (3), TUM (2) and TRI (2).

However in 2017, even after the OG year in Brazil, there were a lower number of Brazilian gymnasts finalists in the WAGC, considering all events and age ranges, as shown in the table 5. This number is comparable only to 2007, when only one pair in TRS became finalist. Even though the International Olympic Committee (IOC) encourages the sports development, when offering accommodation to host countries in the OG, unfortunately the Brazilian international results in TG after 2016, has showed that the legacy was not the expected.

Brazilian participation in World Games

Considered one of the greatest multi-sport events, the World Games (WG) is held every four years by the *International World Games Association* (*IWGA)* with the support of COI. It is basically composed by sport disciplines that are not in OG program and the WG includes some events of TG.

The first edition of WG occurred in 1981, in Santa Clara (USA), where the TRI event was present, but and its last show in this competition took place in Finland/1997, before being included in OG program in 2000. The TRS, DMT and TUM events debuted in 1981 and are still being contested nowadays.

In 2013 edition of WG in Cali (COL), Brazil got the highest place of podium by the first time with an achievement of

gymnast Bruno Martini in the DMT event (Figure 8). In 2017 edition, in Wroclaw (POL), only one gymnast represented Brazil, Mariana Aquino in DMT event, finishing in 7th place (USAGYM, 2017).

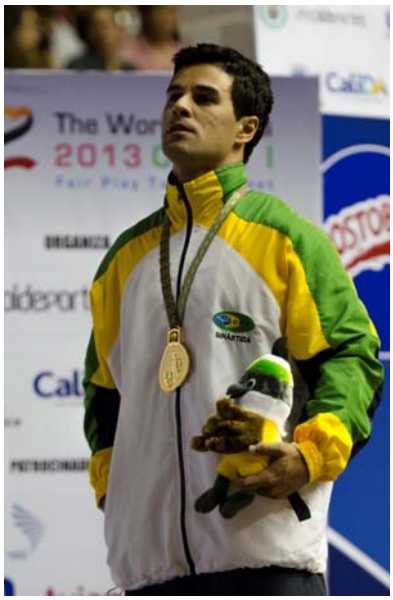

Figure 8. Bruno Martini, DMT Gold medalist on WG/2013. Credits: Ivan Ferreira.

Brazilian participation in Olympic Games

Although, TG popularity rose between 1950 and 1980, it also occurred the rising of catastrophic accidents over recreational trampolines, due to the lack of observation of recommendations and need of safety countermeasures (Chalmers et al., 1994). Those cases seem to have disturbed the discipline recognition process with IOC and consequently its inclusion in OG program.

Two decades later, after the incorporation of FIT to FIG, TG finally became one Olympic discipline, with TRI competitions in OG in Sydney/2000, with the participation of 24 gymnasts divided in men and women categories. After OG in Athens/2004, this number raised to 32 gymnasts, number remained until today.

In the OG in Rio de Janeiro/2016, Brazil was represented on TG by the first time in OG, by being the host country and so having the participation right. By the rules, the place should be attributed to the best gymnast qualified in the previous WC, held in Denmark/2015. In this event, the gymnast Rafael Andrade, has overcome the favorites to the position, Carlos Ramirez Pala and Camilla Gomes, having the privilege to represent Brazil in OG for the first time. Rafael had summed 102.325 points in his two qualifying routines and placed on the 36th position. Camilla Gomes, the best Brazilian in PG in Toronto/2015, had a better position than the gymnast from Goiás (GO) State, but was overtaken by many opponents in the 2nd (free) routine and finished in the 43rd position, with 94.400 points. Carlos Ramirez Pala was better than Rafael in the 1st ("compulsory") routine, but made a mistake and interrupted his 2nd routine on 4th element, finishing on 107th position (64.880 points). Luiz Arruda was 72nd (93.920 points), Ingrid Maior was 48th (92.400 points), and Daienne Lima was 76th (51.510 points) (FIG, 2017d).

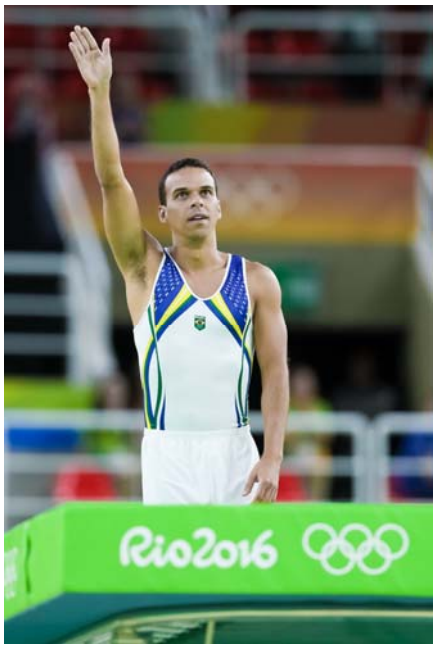

Figure 9. Rafael Andrade in OG/2016. SOURCE: CBG (2016).

In the OG Rio/2016 Rafael Andrade finished in the 15th position in the Qualifying Round with 76.145 points (Figure 9). The first place in the qualifying, the Chinese Lei Gao summed 112.535 points. In fact, the competitive performance of Rafael, and by the most of other senior Brazilian gymnasts, can be considered lower than the level of other gymnasts of OG, mainly the medalists depicted on Table 5, a fact that did not take out their worthiness, considering that the training conditions are still inferior to the existent in the TG reference countries (Arantes, 2015).

Table 6
Olympic Games Medalists.

Olympic Games Edition	Men	Women
2000 Sydney, Australia	1. Alexandre Moskalenko (RUS) 2. Ji Wallace (AUS) 3. Mathieu Turgeon (CAN)	1. Irina Karavaeva (RUS) 2. Oxana Tsyhuleva (UCR) 3. Karen Cockburn (CAN)
2004 Athens, Greece	1. Yuri Nikitin (UCR) 2. Alexander Moskalenko (RUS) 3. Henrik Stehlik (GER)	1. Anna Dogonadze (GER) 2. Karen Cockburn (CAN) 3. Huang Shanshan (CHN)
2008 Beijing, China	1. Lu Chunlong (CHN) 2. Jason Burnett (CAN) 3. Dong Dong (CHN)	1. He Wenna (CHN) 2. Karen Cockburn (CAN) 3. Ekaterina Khilko (UZB)
2012 London, England	1. Dong Dong (CHN) 2. Dmitry Ushakov (RUS) 3. Lu Chunlong (CHN)	1. Rosannagh MacLennan (CAN) 2. Huang Shanshan (CHN) 3. He Wenna (CHN)
2016 Rio de Janeiro, Brazil	1. Uladzislau Hancharou (BLR) 2. Dong Dong (CHN) 3. Gao Lei (CHN)	1. Rosannagh MacLennan (CAN) 2. Bryony Page (GBR) 3. Li Dan (CHN)

Legend: AUS = Australia, BLR = Belarus, CAN = Canada, CHN = China, GER = Germany, GBR = Great Britain, RUS = Russia, UCR = Ukraine, UZB = Uzbekistan. SOURCE: Adapted from USAGYM (2017).

In summary, after the five OG editions, only nine countries won medals in TG competitions in OG, highlighting China (11 medals), Canada (7 medals) and Russia (4 medals). It is possible to observe that the Brazilian participation is far from these reference countries, differently of what is seen in Artistic Gymnastics (men and women), for example, that by the year 2000 started to bring to light various Brazilian gymnasts among the Olympic finalists (Oliveira & Bortoleto, 2009), even accomplishing four Olympic medals between 2012 and 2016 OG editions.

It is important to consider that in 2005 BGC constituted the permanent TG National Team, composed by 8 best national gymnasts, four men and four women. This team trained for 3 years in Curitiba/Paraná (together with the former BGC headquarters in Paraná state) with all expenses paid, a new reality for in the history of this sport in Brazil. Although the technical level of these gymnasts has improved significantly, when the team project was finished, many of these gymnasts did not received any kind of support and consequently quitted sport, causing a definite defalcation to their original clubs. Similar problems were noted on Men´s Artistic Gymnastics (Oliveira & Bortoleto, 2012), Women´s Artistic Gymnastics (Schiavon & Paes, 2011) and Rhythmic Gymnastics (Antualpa & Paes, 2013), suggesting that "permanent national team" do not achieve the expected results.

Nowadays, some gymnasts of the national team, as Camilla and Rafael, are training abroad, a fact that happens mainly on the need to search for better training conditions. The absence of the best gymnasts in the national daily routine is seen as a problem to many Brazilian specialists, since these elite references stay away from the younger gymnasts (Roveri, Carrara, & Bortoleto, 2017).

It is also important to say that the gymnast Bruno Martini, DMT World champion (2011), had also contributed notably to the increase of the technical level of TUM event in a national scope, although the international results were not as impressive as it were in DMT. Another reason for increasing TUM technical level was by improving the "tumbling tracks" made in Brazil, since importing is too expensive. In fact, Brazil still lack of national quality equipment, and needs to import apparatuses and, consequently, has a higher cost for this sport. It should be remembered that the first TUM official track (FIG approved) was acquired by Mr. Bastos in 1998, after Sydney WC, but since that the national tracks became reference to Brazilian gymnasts, hindering the technical evolution of the TG.

Upon national events, it is worth to enhance that BGC hold only 2 TG competitions a year, the BAGC and the Elite/Junior Championship. Consequently, only gymnasts from national teams, mostly of senior category, attend international competitions as South American Championships, PG, world cups and also WC.

Considering the coach education, we should highlight that over TG history in Brazil, mainly before the BGC management control, it was developed several international courses, the majority by the initiative of national clubs, allowing the exchange with coaches of diverse countries (e.g. Belarus, Canada, France, Germany, Portugal, and Russia). During this period, the technical level improved considerably. After 2000, the educational actions diminished significantly, not being possible to find any document showing courses offered by BGC. It's interesting to note that since 2007 FIG offers TG courses in the FIG Academy Program. In total 43 courses were done until 2017, being 11 in South America, but any in Brazil (FIG, 2018), whilst is a reference country in the continent, as mentioned before. While a total of 16 Brazilian coaches have participated in TG FIG courses, there was no adherence of BGC to this program, which is securely nowadays the best option to countries without gymnastics coach education programs, as is the case of Brazil. Curiously, Brazil has several "experts" collaborating with the FIG Academy

program (Andréa João, Newton S. V. Júnior, Marco A Bortoleto), including Mr. Rodolfo Rangel, the only TG expert (FIG, 2017c). It seems reasonable that these experts could be invited by the Brazilians authorities to conduct courses in the national context.

In fact, few state federations really have good regional development. From 22 state federations affiliated to BGC, only 5 (*Minas Gerais, Goiás, Rio de Janeiro, Rio Grande do Sul* and *São Paulo*) had attended regularly national Championships, showing restrict TG development. It seems that one long-term policy, with accessible federation taxes and investment in regularity of regional competitions, as obtained by *Minas Gerais* state federation, should be a good approach to develop TG in Brazil, considering the raise in gymnasts number as well as the results achieved, standing out as the most important TG state federation currently. Our findings shows that TG raising in this state is related to regularly incentives from state government (Silva, 2015) as well from municipalities (Junior, 2012) increasing the training conditions, what include scholarship to the best regional gymnasts. In fact, the governmental support, specially provide by Sport Ministry trough the "Bolsa Atleta" program, still represent the major mechanism for Brazilian sport development, specially in "amateur" disciplines as TG (Oliveira, Bortoleto, 2012; Cortez, 2016; Felizola, 2017; Reis et al, 2015). Nevertheless, although the "Bolsa Atleta" program awarded dozens of scholarships for TG athletes in the last 10 years, it was not possible to achieve good results in the most relevant competitions (WG, OG) (Teixeira et al, 2017; Guimarães, 2009).

As a consequence of these indicated problems, the 2017 BAGC had only 137 gymnasts participating, distributed among all events and ages, being only 35 in senior group, what clearly shows the difficulty TG are facing nowadays in Brazil. In this way, the international competitions results trend to remain similar to those achieved until now, with no perspective to improve them in a short term.

CONCLUSIONS

After the FIG era, Brazil participated in all TG, WC and WAGC editions. However, the country was not able to convert the regularity of participations in a higher technical level in the different events of GT, restricting the medal results on DMT.

Notwithstanding, it is necessary to mention that the results of some gymnasts in international competitions depicted, shows that Brazil has conditions to obtain better results in main events, such as WC and OG. Gymnasts as Rodrigo Rodrigues, Rodolfo Rangel, Bruno Martini and Anna Paula Milazzo, one of the best Brazilian gymnasts of FIT era, who had to abandon sport after suffering an accident, are good examples.

On the other hand, we have the prolonged permanence of veteran gymnasts like Rafael Andrade and Giovanna Venetiglio as members of the TG's national team. According to this, it is also important to point out the gymnast Carlos Ramirez Pala, 15 times Brazilian champion (age group and senior) and qualified reserve for Beijing/2008 OG. Ramirez is a member of the national team since 2002 and is considered a reference gymnast of the TG Brazilian history. Young promises as Daienne Cardoso and Camilla Lopes are still rare.

The taxes charged to take part in national competitions and the trip costs – many times of long distance inside national territory– and the scarce support from clubs and state federations contribute for diminishing the number of gymnasts participating, as well as over TG quality (Roveri, Carrara, & Bortoleto, 2017). Thus, it seems that the lowering of the values of the state federation taxes and even from BGC (annual subscription and affiliation), are underlined as an aspect to be reviewed by Brazilian authorities. The increase of resources provided by sponsors and governmental support (BOC, Municipal and Sport ministry) to acquire equipment and

continued coach education in distinct regions of Brazil is also required, and actions as performed in 2015 by BGC distributing dozens of TG equipment's to some clubs and training centers (BGC, 2015), should be more frequent. Finally, to perform trainings with gymnasts and coaches from national team and clubs (training camps), as well as regular support to clubs and municipalities with minor representatively could facilitate the development of new gymnasts and consequently, an improvement in the technical level of Brazilian TG.

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DO WOMEN'S TEAM MEMBERS COMBINED CAREER DURATIONS IN THE OLYMPIC GAMES AND WORLD CHAMPIONSHIPS INFLUENCE TEAM OUTCOMES? A HISTORICAL EXAMINATION – 1936 TO 2016

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Original article

Abstract

U.S.A.'s Women's Gymnastics team has performed exceptionally at the Olympic Games and World Championships in recent years. One of the aspects of performance thought to be important in team events is the prior experience of the athletes. Prior experience can be measured by an athlete's total number of world level competitions and career durations prior to a given competition. Olympic and World Championship team rosters and team ranks were examined from 1936 to 2016. The number of competitions per athlete and ranks of the teams were tallied and analyzed over the entire period. There were 193 individual athletes and 43 competitions. Athlete career durations were determined by calculation of years between competitions in which the athlete participated. Time-series regression analyses showed no relation between career durations and time while there was a statistically significant trend of team rank reduction (better team finishes) over time. After dividing the study period into two-time segments, there were no statistical differences between early and late periods in career durations, while there were statistical differences in team ranks over the same durations. Olympic Games and World Championships were separated and again there was no statistical difference between the two competition levels on career durations nor did the ranks of the two periods show statistical differences. There did not appear to be a relationship between career durations and team performance ranks.

Key words: *historical trends, team membership, world level competitions.*

INTRODUCTION

Women's gymnastics has been a part of the Olympic Games since 1928, but in different forms and using different activities and apparatuses. Women's *artistic* gymnastics began at the 1952 Olympic Games. The U.S. women's gymnastics team, as a part of the Olympic Games and Olympic movement, has most recently been a source of pride directly for American gymnastics and indirectly to the American people. The rise of women's gymnastics to its current world level has not happened suddenly (Cervin, 2017).

The history of the development of U.S. women's gymnastics is bound together with national and international politics (Cervin, 2017). The Cold War of the mid to late 1900s resulted in using the competitive successes of athletes to further national and international agendas. The international arena of gymnastics was also marked by competition both on the apparatuses and in politics. Even within U.S. Gymnastics power struggles were often hostile and bitter (Laptad, 1971).

"The US is important not only as the adversary of the Soviet Union both politically and in the sporting context of the Cold War, but also in terms of its progression in gymnastics throughout this period – from virtual irrelevance to world's best." (Cervin, 2017), p 56.

Gymnastics, particularly women's gymnastics, has followed a rocky path to acceptance and recognition. The sport of gymnastics has been in and out of acceptance by the International Olympic Committee (IOC). The IOC struggled with gymnastics as an Olympic sport because of the number of athletes involved compared to other sports and the multiple medals available to winners. Larissa Latynina held the record for the most Olympic medals for fifty years only to be dethroned by Michael Phelps (Cervin, 2017). Avery Brundage questioned whether gymnastics was too simple when a single athlete could win up to eight medals (men) or six medals (women) in one competition when the decathlete could only win one medal while competing in ten events over two full days (Cervin, 2017). Gymnastics has also been criticized for having "artificial" teams meaning that gymnasts do not compete as a team but as separate individuals (Cervin, 2017).

In spite of the criticisms of Avery Brundage, the gymnastics community considers the team competitions to be extremely important. The team score and rank are determined by the sum of the athletes' scores thereby relying on all of the participating athletes to provide their highest scores for the team total. Coaching folklore has often promoted the idea that previous experience of Olympic and World Championships team members is important for team cohesion and competitive outcomes. Previous investigations have addressed the likelihood of an athlete repeating on Olympic and World Championships teams among U.S. male (W. A. Sands et al., 1993) and female (W. A. Sands & Henschen, 1992) gymnasts. The earlier investigations showed that the probability of any given female gymnast repeating from one major international competition (i.e., Olympic Games or World Championships) was low, even when the two competitions were less than one calendar year apart. Female gymnasts showed a probability of approximately 29% for repeating major international competitions once (i.e., two teams), and approximately 15% for repeating twice (i.e., three teams) (W. A. Sands & Henschen, 1992). Male gymnasts showed a 43% and 26% probability of repeating for one and two major competitions, respectively (W. A. Sands et al., 1993). Despite the low probability of repeating team participation, it is a common belief that previous experience at international level competition, is important for success in sports (T. O. Bompa & Haff, 2009). Given the recent successes of the U.S. Women's teams, team member experience may be an explanatory factor in these successes. For example, the USA women's gymnastics team received a team gold medal in the Olympic Games of Rio, 2016, with two of the five team members, Aly Raisman and Gabby Douglas, competing in the London and Rio Olympic Games.

Peaking at major competitions is a primary aim of elite athlete training programs (Bartonietz & Larsen, 1997; T. Bompa, 1984a, 1984b; Mujika, 2009; Pyne, Mujika, & Reilly, 2009; Sanchez et al., 2013). Systematic preparation strategies for peak performance in the decisive moments of competition remain elusive (W. A. Sands & McNeal, 2000). Female gymnasts often train for more than a decade before reaching the minimum age (16 y) for eligibility to compete in an Olympic Games or World

Championships, and then face the rigid and demanding competitions also necessary to qualify (B. Sands, 1984; W. A. Sands & McNeal, 2000).

The timing of peak performance relative to physical maturity in female gymnasts and other female athletes has been an important consideration linked to the competitive opportunities the athlete may have. Smallness and lightness are well known characteristics of the successful gymnast, both are enhanced by late maturation and high training loads (Bacciotti, Baxter-Jones, Gaya, & Maia, 2017; Beunen, Claessens, Thomas, Philippaerts, & Lefevre, 2000; Claessens, Lefevre, Beunen, & Malina, 1999; Claessens, Lefevre, Beunen, & Malina, 2006; R.M. Malina et al., 2006; Thomis et al., 2005; Weimann, Witzel, Schwidergall, & Bohles, 2000). Age eligibility can influence the timing of the elite gymnast's quest for world level competition. Athletes have suffered from experiencing sexual maturation earlier than optimal for world competitions (Beunen & Malina, 1996; Claessens et al., 1992; Geithner, Malina, Stager, Eisenmann, & Sands, 2002; R.M. Malina, 1999; R. M. Malina et al., 2013; Normile, 1996; Sanders, 1990; W. A. Sands, McNeal, & Jemni, 2002). There is a constellation of factors that may contribute to the performance of female gymnasts at the Olympic Games and World Championships. Competitive longevity among these gymnasts may be important in the overall team performance.

Team selection procedures have varied widely over many years based on competitive performances, committee deliberations, strong personalities and other factors. The purpose of this investigation was to characterize and analyze the durations of careers of U.S. elite female gymnasts who had qualified for Olympic Games and World Championships teams and compare these with the team rank from 1936 to 2016.

METHODS

The historical period (1936-2016) under examination was based largely on the availability of historical records. Team ranks were compared to team athletes' career durations, again because of availability of these records. Data were acquired from a publicly accessible website created and maintained by USA Gymnastics:

- World Championships https://usagym.org/pages/pressbox/history/worlds_rosters_women.html
- Olympic Games https://usagym.org/pages/pressbox/history/olympics_rosters_women.html

Team rosters were scraped from the USA Gymnastics website and copied to an Excel^{tm} spreadsheet (Excel 2016, Redmond, WA, USA). All team members including alternates career durations were tallied and examined for trends. Analyses were conducted using built-in Excel functions and statistics software (ProStat Version 6.0, 2011, Pearl River, NY USA). Descriptive statistics, time-series regression analyses, and non-parametric two-tailed Wilcoxon Signed Ranks tests were used (Field, 2000; Wilcoxon, 1945). Rejection of the null hypothesis was set at $\rho \leq 0.05$.

RESULTS AND DISCUSSION

The historical records of team rosters from the period 1936 to 2016 saw 193 individual gymnasts as members of 43 Olympic and World Championship teams. Team rosters varied depending on the policies and procedures in place at the time of the team selection. The average number of competitions or teams for these athletes was 1.69 (SD = 1.03 competitions, Median = 1 competition, Range = 1,6 competitions) (Figure 1). The length of Olympic Games and World Championships athlete career durations averaged 2.11y (SD = 1.89y, Median = 1y, Range = 1,11y).

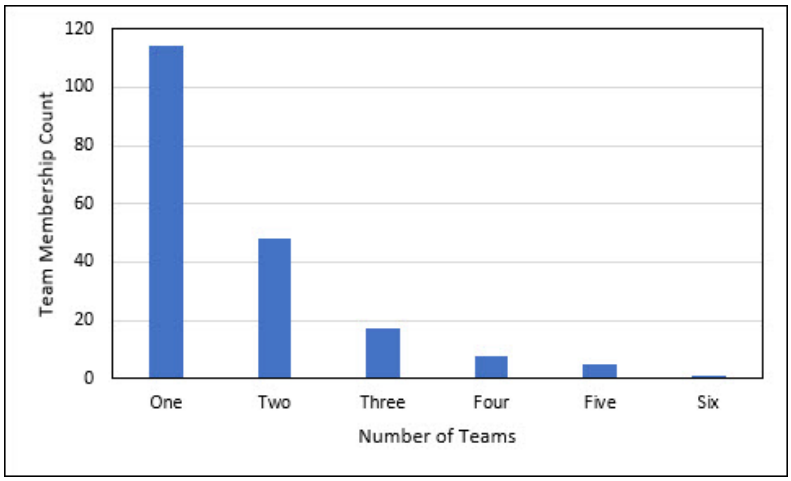

Figure 1. Distribution of the number of competitions attended by USA women's gymnasts.

Figure 2 shows the time-series of team ranks and career durations for all competitions from 1936 to 2016. A linear regression analysis was conducted to clarify the overall trends of progression through the historical period. The linear regression analysis showed a statistically significant decline (better team ranks) throughout the period ($r_{(41)}$ = 0.73, $p < 0.001$) while the athlete career durations increased slightly, but not statistically significantly ($r_{(41)}$ = 0.069, $p > 0.05$).

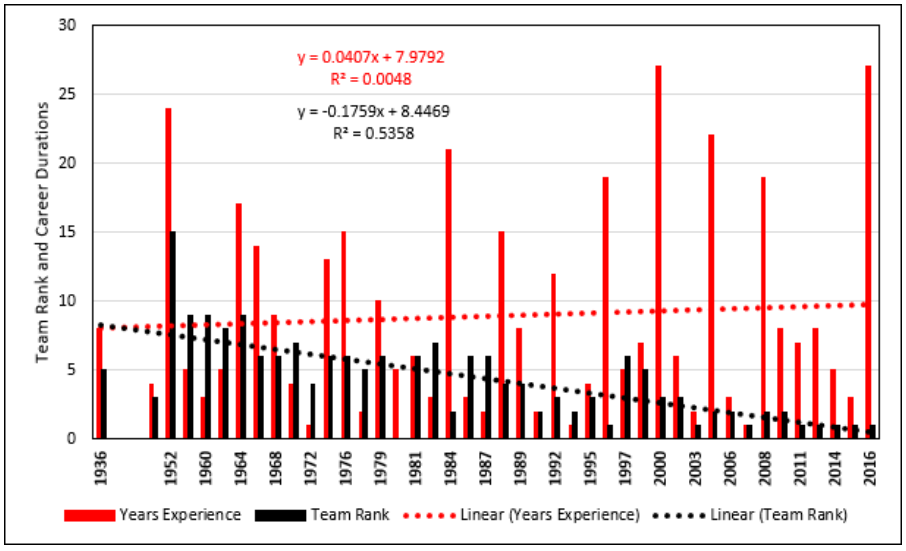

Figure 2. Linear regression analysis of athlete careers and team ranks. The time gap between 1936 and 1948 is the period of the second world war during which no Olympics or World Championships competitions were held.

Wilcoxon Signed-Ranks comparisons were calculated on the career durations and team ranks between the periods 1936 to1974 and 1976 to 2016. The results showed no statistically significant difference between the time periods for career lengths (Mdn 1936-1974 = 5, Mdn 1976-2016 = 8; T = 61, p = 0.46, r = 0.11) or team ranks (Mdn 1936-1974 = 5, Mdn 1976-2016 = 6; T = 55.5, p = 0.85, r = 0.03).

Olympic data were separated from World Championships to determine if the different competitions resulted in different trends as determined by the Wilcoxon Signed-Ranks tests. Career durations did not show a statistically significant difference between

the two major competition types (Mdn Olympics = 6.5, Mdn World Championships 5.5; T = 38, p = 0.66, r = 0.07). The team ranks were statistically different between the major competition types (Mdn Olympics = 6.5, Mdn World Championships = 5.5; T = 40.5, p = 0.033, r = 0.33). Figures 4 and 5 show the time-series of both career durations and team ranks for both types of competitions. The trends for career durations in both competition types were not statistically different from zero (Olympic Games $r_{(15)}$ = 0.01, p > 0.05; World Championships $r_{(24)}$ = 0.14, p > 0.05). Team ranks for both competition types showed statistically significant trends (Olympic Games $r_{(15)}$ = -0.64, p < 0.001; World Championships $r_{(24)}$ = -0.63, p < 0.001).

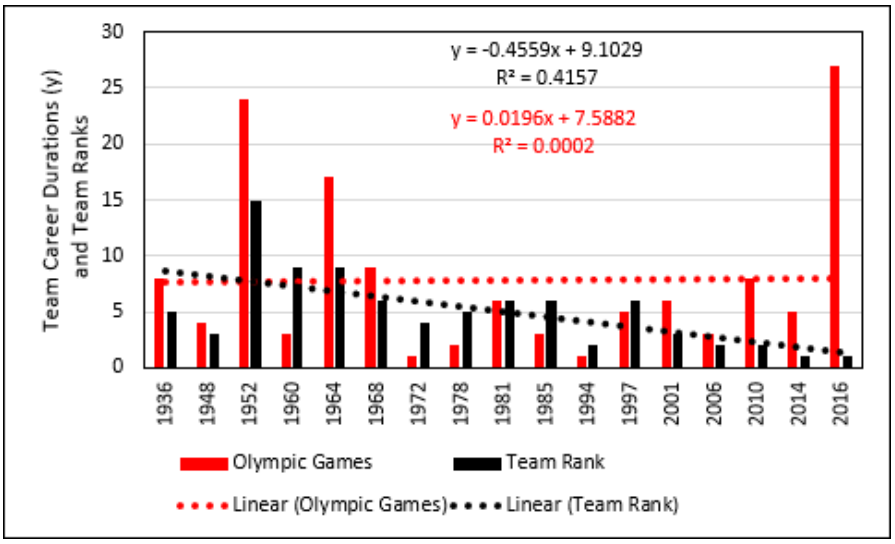

Figure 3. Olympic Games trends of career durations and team ranks.

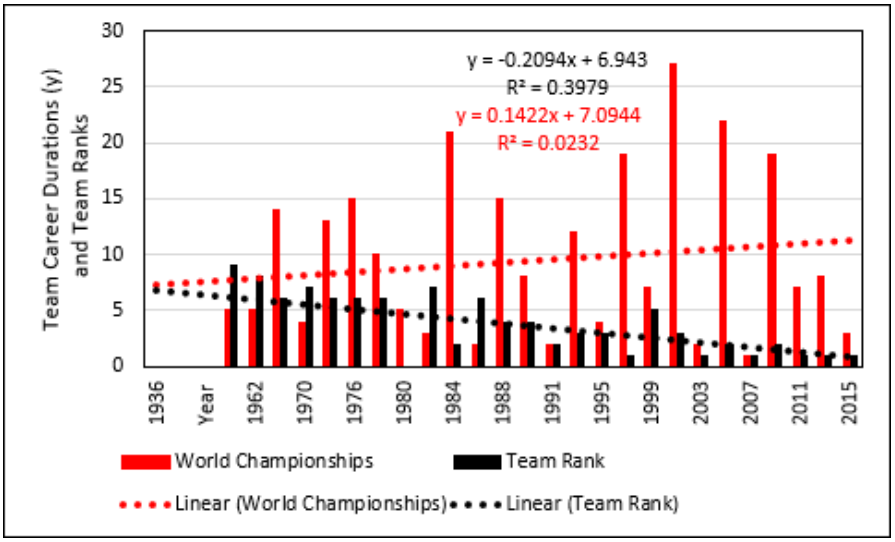

Figure 4. World Championships trends of career durations and team ranks.

DISCUSSION

The obvious trends of the team ranks showed that the U.S. Women's Team continually improved during the examined historical period with particular emphasis on the years following 1962. Moreover, the separation of trends using the polynomial regression calculations showed that following approximately 1976 the ranks and

career durations trended differently. Prior to 1980, the Olympic and World Championships competition were conducted approximately four years apart staggered such that there were two years between these major competitions. After 1980, the number of Olympic Games and their positions in the calendar remained the same with World Championships occurring at uneven intervals and formats. This discrepancy in timing gave the athletes in the latter calendar period an advantage by having more high-level competitions to attend.

Career durations of the athletes in these competitions does not appear to contribute to the team rank outcomes, countering the coaching folklore regarding team member prior experience. None of the statistical tests of career durations between defined groups were statistically significant. Moreover, the trends of career durations were also not statistically significant.

A number of potential influencing factors occurred during the examined time periods. Two Olympic Games were boycotted, once by the Soviet Union and its allies and once by the U.S. and its allies, although participation of the allies in both instances was not complete. Politics and judge cheating were well known during this period (Ansorge & Scheer, 1988; Boen, van Hoye, Auweele, Feys, & Smits, 2008; Donovan, 1991; Fie & Crowley, 2003; Looney, 2004; Plessner, 1999; W. A. Sands & Kipp, 1992). During the Cold War, Eastern bloc countries tended to work together to control judges scores and athlete and team ranks. As such, substantial changes in women's artistic gymnastics rules (Code of Points) may also have influenced gymnasts' career duration. For example, the exclusion of the compulsory routines from the official competitions (International Gymnastics Federation, 1997), and the abolishment of ten points as a maximum score that a gymnast could obtain (International Gymnastics Federation, 2000), transferred the stress of the competition to the optional routines and introduced a 'world record' philosophy that resulted in a rapid development and focus on the difficulty of the competitive routines (Donti, Donti, & Theodorakou, 2014). Thus, older and more experienced gymnasts may have missed participation as team members if they could not meet the level of difficulty of their younger counterparts.

Gymnastics also changed with the IOC's shift in the enforcement of amateurism. Gymnasts were able to make money from commercial endorsements and prize money. However, neither political maneuvering nor the availability of funds seemed to have changed the career durations of the U.S. Women's Team athletes.

"However, with relaxed rules on professionalism in the 1980s turning the tide on potential income from Olympic sport, it cannot be coincidence that at this point American gymnasts broke through into international success. Although improved training systems, better networking, and the 1984 boycott also played a part in creating a more favourable environment for Western gymnasts, the new economic situation was also crucial to changes in the power balance of international gymnastics." (Cervin, 2017), p 229.

CONCLUSIONS

This study must conclude that the ranks of the women's World Championships and Olympic Games teams marked an easily discernible trend of improved results. However, the career durations did not appear to be related to team rank results. Future research investigating the possible contributing variables to the long-term rise of USA Women's Gymnastics should pursue other social, political, scientific, and other variables.

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RELATIVE AGE EFFECT AMONG OLYMPIAN GYMNASTS

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Original article

Abstract

Relative age effect (RAE) is a worldwide phenomenon described as consequences of age variations between individuals competing in the same cohort. RAE is based on systems that use January 1 as a cut-off date, probably used to attempt to minimize developmental differences between ages and to ensure a more equitable competition. Previously, in artistic gymnastics, a majority of studies on RAE was conducted in gymnasts of national levels. This study analysed RAE both among and between elite female (N_F=1268) and male gymnasts (N_M=1186) who participated at all Olympic Games held from 1964 to 2016. By using χ^2 test, significant difference were found: 1) within frequencies of total sample of male gymnasts born in a certain month ($p<0.001$); 2) within frequencies of groups of male gymnasts apparatus finalists born in a certain month ($p<0.005$); 3) within frequencies of groups of male apparatus finalists born in a certain quarter of the year ($p<0.005$); 4) within frequencies of groups of male apparatus finalists born in a certain half of the year ($p<0.005$). As far as female gymnasts are concerned, significant differences have not been found within frequencies of any female group born in a certain month, quarter or halves of the year. Regarding differences between genders, no significant differences have been obtained between frequencies of male and female gymnasts born in certain month, quarter and halves of the year. Despite certain differences among and between genders, the general conclusion was that RAE is not present in elite gymnasts of both genders.

Key words: *RAE, female gymnasts, male gymnasts, differences.*

INTRODUCTION

On the way of reaching Olympic quality, gymnasts are confronting with many factors, and one of the them is time: time needed for reaching the peak of performance of the continuously increased number of the most difficult elements from Code of Point (CoP; prescribed by the Technical Committee (TC) of the Fédération de Internationale de Gymnastique (FIG). Furthermore, from all those Olympians, only those who perform the most difficult elements with the highest technical end aesthetical precision qualify for the highest levels of Olympic gymnast competition – Apparatus Finals.

However, time (irrespective of whether it is a time-period of changes that are followed by biological maturation or time-length of the training process) is not equal

from the point of the female and male artistic gymnastics.

Female gymnasts start with training around the age of 6 and are included in trainings characterised by deliberate practice-high-quality practice (Ericsson, 2007, 2008) around the age of 10 in order to reach peak strength and peak performance of all required skills somewhere around the age of 16 (Tofler, Stryer, Micheli, & Herman, 1996; Arkaev & Suchilin, 2004). "Catching up" of the peaks is correlated with attempts to teach female gymnasts as many skills as possible before reaching their biological maturity. Although it is delayed, compared to the "normal" population (as a consequence of long hours of training (Caine, Bass, & Daly, 2003; Georgopoulos et al., 2012) and/or because gymnasts have been selected as short, normal, late-maturing individuals (Malina et al., 2013)), influence of the maturity on the female gymnasts is the same as on the "normal" population: hips and torso are widening, and the volume of fat tissue is increased. These morphological changes disrupt performance of even basic gymnastic elements (Ryan, 1995) and cause loosing of an "ideal" female gymnast body (tiny "pixie-like" feminine bodies with a superhuman power; Barker-Ruchti, 2009; Weber & Barker-Ruchti, 2012; Cohen, 2013).

Male gymnasts, unlike from female gymnasts, typically do not experience intensive, rigorous training before the age of 14 or 15, due to performance dependence of the most male gymnastics skills for the extreme levels of strength, especially of the upper body. Because male gymnasts are also typically characterized with a shorter stature, later maturation and a slower rate of growth than the normal population (Malina, 2014), this is the period when increasing of levels of the Testosterone (required for the development of the muscle mass and development of the strength and power) happens. An increase of muscle mass and development of power and strength, without significantly mobilizing the aerobic processes, enables male gymnasts to perform the most difficult elements (Dallas, Zacharogiannis, & Paradisis, 2013).

Despite different time of starting the intensive training, deliberate practice is considered to be a fundamental factor for success in artistic gymnastics (Côté & Fraser-Thomas, 2008). However, many previous studies, conducted primarly on female gymnasts, argued about a "negative" impact of the earlier attainment of deliberate practice on maturity. Results of those studies suggested that early deliberate practice was causing a range of physical problems like stunted growth, bone deformity and a delayed onset of menarche (Caine, Lewis, O'Connor, Howe, & Bass, 2001; Cassas & Cassettari-Wayhs, 2006; Daly, Bass, & Finch, 2001; Dresler, 1997; Lindholm, Hagenfeldt, & Hagman, 1995; Tofler, Stryer, Micheli, & Herman, 1996) as well as some psychological problems like distorted body-image, self-confidence, and dietary habits (Lindholm et al., 1995; Martinsen, Bratland-Sanda, Eriksson, & Sundgot-Borgen, 2010). It was specially noted from the mid-1960s through the 1980s when the decrease of the mean age, height, and weight of world class female artistic gymnasts was confirmed (Malina, 1994; Ryan, 1995; Malina, Bouchard, & Bar-Or, 2004; Claessens, Lefevre, Beunen, & Malina, 2006; Kerr, Berman, & De Souza, 2006; Martindale, Collins, & Abraham, 2007; Barker-Ruchti, 2009). Although the above mentioned problems were far more contentious in Women's Artistic Gymnastics (WAG) rather than in Men's Artistic Gymnastics (MAG), with the aim of protecting the musculoskeletal development of young competitors, lengthening gymnasts careers, preventing early burnout, helping to reduce injuries, and redirecting a positive image of sport to the public, spectators, and media (Eagleman, Rodenberg, & Lee, 2014), during the last three decades the FIG gradually increased its minimum age requirements for both genders. The minimum age requirement for gymnasts refers to the chronological age requirement for participation in senior competitions sanctioned by the FIG. Prior to 1981 the

minimum required age was 14 years of age, in 1981 it was increased to 15 years of age and from 1997 both genders older than 16 could participate in World Championships. However, female gymnasts who turned 16 and male gymnasts who turned 18 in the current year could participate in the Olympic Games (OG) but only as members of national teams. These increases of minimum required age probably influenced the increase of the average age of female gymnasts and decrease of the percentage of youngest female gymnasts in the period from 1966 to 2016 (Delaš Kalinski, Atiković, & Jelaska, 2018). However, an increase in average age for male gymnasts in the period from 1984 to 2016 was never attributed to increase of the FIG's minimum age but to the increased demands of MAG, respectively to the prolonged training processes in order to attain a necessary level of strength required to perform the most difficult skills of MAG (Delaš Kalinski, Jelaska, & Knežević, 2017).

Starkes (2000) indicated that other factors besides deliberate practice contribute to sport expertise; some coaches' talents might be masked by a phenomenon known as a relative age effect (RAE). Barnsley, Thompson and Barnsley (1985) gave a definition of RAE saying it refers to the subtle chronological age discrepancies between individuals within annually age-grouped cohorts. RAE presents favouritism toward selecting athletes born early in the birth year (Kirkendall, 2014). RAEs refer to a specific selection, participation, and attainment (dis)advantages occurring as a result of physical and cognitive variability (Musch & Grondin, 2001). The main reason for RAE is to attempt to minimize results of physical maturation (increased height and mass) and their accompanying performance factors (correlated and influenced by an increase muscle mass: sprinting, explosive power (Cobley, Baker, Wattie, & McKenna, 2009) in order to provide more equitable competition.

RAE in sport was first reported in Canadian ice hockey and determined how a greater proportion of relatively older athletes (born in the first three months of the year) compete in elite team sports, when compared to their younger counterparts (ones born closer to the end of the age-band (Grondin, Deshaies, & Nault, 1984; Barnsley et al., 1985)). Later, in a review article Cobley et al. (2009) analysed 38 studies on relative age effects (spanning 1984-2007, containing 253 independent samples across 14 sports and 16 countries) and confirmed RAE, with few exceptions, for a variety of sports for both genders over a range of competition and development levels.

Compared to male athletes, only a few of the studies examined RAE in female athletes. Researchers conducted on a female team sports highlight an over-representation of athletes born in the second-quartile at elite levels of performance (Musch & Grondin, 2001; Baker, Schorer, Cobley, Bräutigam, & Büsch, 2009; Cobley et al., 2009; Baker, Janning, Wong, Cobley, & Schorer, 2014; Delorme, Boiché, & Raspaud, 2010; Weir, Smith, Paterson, & Horton, 2010; Till et al., 2010; Cobley et al., 2009; Hancock, Seal, Young, Weir, & Ste-Marie, 2013; Sedano, Vaeyens, & Redondo, 2015). Some researchers claim that the effect may be reversed at the elite level because relatively younger athletes develop superior skills to remain in the sport (Schorer, Cobley, Büsch, Braütigam, & Baker, 2009) and that relatively older elite athletes drop out of sport earlier (Bäumler, 1998; Schorer et al., 2009).

When compared with team sports, there seems to be a lack of studies of RAE in individual sports, and reported datasets are conflicting as well (Cobley et al., 2009; Raschner, Muller, & Hildebrandt, 2012; according to Albuquerque et al., 2015). Within individual sports, the presence of RAE was confirmed in skiing (downhill and Nordic; Baker et al., 2014), tennis and archery (Baxter-Jones, 1995), within heavier Olympic judo athletes (Albuquerque et al., 2013), within Olympic wrestlers (Albuquerque et al., 2014) and in athletics (Sayavera et al., 2017). Individual female aesthetic sports (dance, gymnastics, figure

skating, diving) seem less prone to RAE (van Rossum, 2006; Baker et al., 2014; Wattie et al., 2014).

General conclusion was made by comparing RAE studies between genders: the magnitude of the RAE in women's sports was smaller due to a less intense competition at an early age. Raschner et al. (2012) suggested that female sports disciplines are not as strength-related as the male variants, and as a consequence, the maturation-related developmental lead is not as decisive. Because female artistic gymnastics is a strength-related sport which prefers: 1) young "pixie-like" bodies (Barker-Ruchti, 2009; Weber & Barker-Ruchti, 2012; Cohen, 2013); 2) late-maturing individuals (Malina et al., 2013); 3) shorter, lighter in body weight, having lower values of subcutaneous fat, narrower hips and broader shoulders, athletes who "survive" early amounts of deliberate practice and become competitive gymnasts (Claessens & Lefevre, 1998); 4) shorter and lighter in body weight athletes because of biomechanical advantages (Monsma & Malina, 2005); 5) slowly growing athletes who have tendency not to pass through major problems with consistency of performance of gymnastic elements (Kerr, Barker-Ruchti, Schubring, Cervin, & Nunomura, 2015), the potential complexity of RAE is highlighted. However, only a few studies on national level gymnasts have been conducted and the following conclusions were made: 1) among elite female British gymnasts RAE was not observed (Baxter-Jones, 1995); 2) there is an atypical RAEs effect between female gymnasts; athletes born in the second and third quartiles were more frequently seen in national teams than athletes born in the first and fourth quartiles (Baker et al., 2014); 3) relatively older female gymnasts, usually because psychological responses of female gymnasts on puberty (increase of depressive symptoms and weight concerns, decrease of feelings of self-worth) have been shown to drop out more frequently than relatively younger gymnasts (Wattie et al., 2014); 4) during childhood and early adolescence (under the age of 15), relatively older female gymnasts might excel relatively younger athletes (Hancock, Starke, & Ste-Marie, 2015) due to the increased cognitive maturity that may be needed for deliberate practice training conditions (Baker et al., 2014).

Studies of RAE on a sample elite female international gymnasts have not been found, while RAE was never determined on a sample of male Olympian gymnasts, participants of Olympic Games held from 1980 to 2016 (Delaš Kalinski et al., 2017).

Considering all the above mentioned differences between men's and women's gymnastics, as well as a very few researches analysing RAE effects within the same sport, but among the different genders, the problem of this research was set and it was to analyse RAE among elite international gymnasts. The aims were: 1) to determine, for each gender, differences between frequencies of gymnasts born in a certain month, quarter and half of the year; 2) to determine differences within frequencies of male and female gymnasts born in certain month, quarter and half of the year; 3) to determine, for each gender and between genders, differences in frequencies of gymnasts who competed on different levels of Olympic gymnast competitions.

METHODS

Subjects

The research tended to include all elite male (N_M=1193) and female (N_F=1280) senior gymnasts who participated in All-Around Qualifications (AAQ) and Apparatus Finals (AF) at all OG held from 1964 to 2016. The total frequencies of AAQ and AF participants differ in the analysed period due to FIG rules valid at certain OG. For males: at the OG1964 N_{MAAQ}=114 and N_{MAF}=16; at the OG1968 N_{MAAQ}=103 and N_{MAF}=14; at the OG1972 N_{MAAQ}=84 and N_{MAF}=11; at the OG1976 N_{MAAQ}=151 and N_{MAF}=20; at the OG1980 N_{MAAQ}=36 and N_{MAF}=36; at the OG1984 N_{MAAQ}=36 and N_{MAF}=48; at the OG1988 N_{MAAQ}=36 and N_{MAF}=48; at the OG1992 N_{MAAQ}=36 and

N_{MAF}=48; at the OG1996 N_{MAAQ}=35 and N_{MAF}=48; at the OG2000 N_{MAAQ}=36 and N_{MAF}=48; at the OG2004 N_{MAAQ}=24 and N_{MAF}=50; at the OG2008 N_{MAAQ}=24 and N_{MAF}=48; at the OG2012 N_{MAAQ}=24 and N_{MAF}=49; at the OG2016 N_{MAAQ}=22 and N_{MAF}=48. For females: at the OG1964 N_{FAAQ}=69 and N_{FAF}=14; at the OG1968 N_{FAAQ}=91 and N_{FAF}=11; at the OG1972 N_{FAAQ}=104 and N_{FAF}=13; at the OG1976 N_{FAAQ}=57 and N_{FAF}=17; at the OG1980 N_{FAAQ}=49 and N_{FAF}=16; at the OG1984 N_{FAAQ}=49 and N_{FAF}=18; at the OG1988 N_{FAAQ}=71 and N_{FAF}=17; at the OG1992 N_{FAAQ}=73 and N_{FAF}=18; at the OG1996 N_{FAAQ}=87 and N_{FAF}=18; at the OG2000 N_{FAAQ}=76 and N_{FAF}=21; at the OG2004 N_{FAAQ}=72 and N_{FAF}=26; at the OG2008 N_{FAAQ}=73 and N_{FAF}=25; at the OG2012 N_{FAAQ}=72 and N_{FAF}=25; at the OG2016 N_{FAAQ}=70 and N_{FAF}=28.

However, due to the inability to find the date of birth for all participants, the total sample of entities for male gymnasts was N_M=1186 and for female gymnasts N_F=1268. Each gender total sample was analysed trough three different insights: 1) as a group of total sample (TS); 2) as a group of participants of All-Around Qualifications (AAQ); 3) as a group of participants who qualified for Apparatus Finals (AF).

Names and birthdates of the sample were collected from open-access Internet websites, mostly from the official OG website https://www.olympic.org/gymnastics-artistic. There were no ethical issues involved in the analysis and interpretation of the data used, as these data were obtained in their secondary form and were not obtained by experimentation. The use of open access or Internet data in RAE studies has previously been described in other studies (Côté et al., 2006; Medic, Starkes, Weir, Young, & Grove, 2009; Albuquerque et al., 2012; Albuquerque et al., 2015).

Variables

The variable sample is represented by a set of: 1) date of AAQ competition at the OG held from 1964 to 2016; 2) date of birth of male gymnasts; 3) date of birth of female gymnasts; 4) participation in AAQ or in AF at all OG held from 1964 to 2016.

The information on dates of competitions and on participation of gymnasts at a certain level of competition (AAQ or AF) have been retrieved from the specialized website for gymnastics results (www.gymnasticsresults.com, accessed from 2 September to 18 October 2016).

Statistical Analysis

Conversion of a date of birth into chronological age was done using MS Excel function *YEAR*. Parameters for this function were date of birth of the competitors and the date of specific competition that was analysed.

There are two traditional investigations of RAE: 1) classifying the date of birth to a certain quarter of the year (Q1: January to March; Q2: April to June; Q3: July to September; and Q4: October to December) for data analysis (Côté et al., 2006; Delorme et al., 2010; Delorme, Chalabaev, & Raspaud, 2011; Albuquerque et al., 2012, 2013); 2) classifying the date of birth to a certain half of the year (born from January to June were classified into the first half of the year, and born from July to December were classified to the second half of the year; Edgard & O´Donoghue, 2005). In case of both genders from the current study data analysis included both mentioned methods, as well as representation and analysis of frequencies of competitors born in particular month. Within a gender (for each group (TS, AAQ, and AF)) Chi-square (χ^2) test was applied to identify differences between frequencies of affiliation of a gymnast's birth date to a certain month, a quarter of the year and half of the year. Also, for each group (TS, AAQ, and AF), χ^2 test was applied to identify differences between genders in frequencies of affiliation of the gymnast's birth date to a certain month, a quarter of the year and half of the year. For all applied analyses, type I error was set at α=5%. All data were calculated using data

analysis software system Statistica 13.2 (Dell Inc., Tulsa, OK, USA).

RESULTS

Table 1
Affiliation of the date of birth of male and female participants at the Olympic Games held from 1964 to 2016 to a particular month of the year.

	TS			AAQ			AF		
	M	**F**	χ^2 **p**	**M**	**F**	χ^2	**M**	**F**	χ^2 **p**
N month	**1186**	**1268**	**df=1**	**655**	**1003**	**df=1**	**531**	**265**	**df=1**
1	117	118	0.22 0.63	67	93	0.42 0.52	50	25	0.00 0.99
2	94	105	0.10 0.75	48	78	1.92 0.17	46	27	0.50 0.42
3	105	99	0.94 0.33	59	77	0.93 0.34	46	22	0.03 0.86
4	80	104	1.88 0.17	50	88	0.68 0.41	30	16	0.05 0.82
5	87	107	1.02 0.31	49	84	0.43 0.51	38	23	0.58 0.45
6	102	102	0.25 0.62	65	74	3.33 0.07	37	28	3.05 0.08
7	74	97	1.88 0.17	44	79	0.78 0.38	30	18	0.41 0.52
8	104	122	0.53 0.45	54	100	1.41 0.24	50	22	0.27 0.60
9	129	126	0.58 0.45	68	98	0.16 0.69	61	28	0.15 0.70
10	95	101	0.00 0.97	46	77	0.24 0.62	49	24	0.01 0.92
11	102	100	0.41 0.52	50	81	0.00 0.97	52	19	1.49 0.22
12	97	87	1.54 0.22	55	74	0.57 0.45	42	13	2.88 0.09
χ^2	25.07	12.99		14.01	10.95		21.20	11.45	
df	11	11		11	11		11	11	
p	**0.01**	0.29		0.23	0.45		**0.03**	0.41	

Legend: Data are represented as frequencies of male/female gymnasts born in a certain month of the year, TS – total sample, AAQ – All-Around Qualifiers, AF – Apparatus Finalists, month – birth month, M – male gymnasts, F – female gymnasts, χ^2 – Chi square test value, p – level of significance, df – degrees of freedom

At the OG held from 1964 to 2016 the lowest percentage of all male participants was born in July (7%) while the highest percentage was born in September (10%). In the sample of female participants at the OG from 1964 to OG2016, the lowest percentage of participants was born in December (6%) while the highest percentage was born in September (10%). Similar results have been found for the male AAQ participants (the lowest percentage was born in July (7%) and the highest

percentage was born in September (10%). The lowest percentage of AAQ female participants was born in June and December (7%) and the highest percentage was born in August (10%). The lowest percentage of AF male participants were born in April and July (5%) and the highest percentage was born in September (11%). The lowest percentage of AF female participants was born in December (5%) and the highest percentage was born in September (10%).

Despite different frequencies of male and female participants born in a certain month of the year (Table 1), in all three groups (TS, AAQ and AF) a significant difference between frequencies of gymnasts born in certain month of the year, was determined only among the men's TS participants (χ^2=25.07, p=0.01) and among the frequencies of men's AF (χ^2=21.20, p=0.03). In both genders for all other groups, significant differences have not been determined between frequencies of gymnasts born in a certain month of the year. Significant differences have not been determined between genders (in all observed groups) for frequencies of OG participants born in a certain month of the year.

Table 2

Affiliation of the date of birth of male and female participants of the Olympic Games held from 1964 to 2016 to a particular quarter of the year.

	TS			AAQ			AF		
	M	**F**	**χ^2 p**	**M**	**F**	**χ^2**	**M**	**F**	**χ^2 p**
N quarter	**1186**	**1268**	**df=1**	**655**	**1003**	**df=1**	**531**	**265**	**df=1**
1	316	321	0.56 0.47	174	247	0.78 0.38	142	74	0.12 0.72
2	269	313	1.35 0.25	164	246	0.09 0.76	105	67	3.17 0.08
3	307	346	0.62 0.43	166	278	1.14 0.29	141	68	0.07 0.79
4	294	288	1.47 0.23	151	232	0.00 0.97	143	56	3.17 0.08
χ^2	4.23	5.41		1.67	4.51		7.76	2.55	
df	3	3		3	3		3	3	
p	0.24	0.14		0.65	0.21		**0.05**	0.47	

Legend: Data are presented as frequencies of male/female gymnasts born in a certain quarter of the year, TS – total sample, AAQ – All-Around Qualifiers, AF – Apparatus Finalists, quarter-quarter of the year, M – male gymnasts, F – female gymnasts, χ^2 – Chi square test value, p – level of significance, df – degrees of freedom

As seen through quarters (Table 2), like in analysis through the frequencies of gymnasts born in a certain month of the year, different frequencies of male and female gymnasts have been determined to be born in certain quarter of the year: 1) in the TS of male gymnasts the highest frequencies refers to gymnasts born in the first quarter (26%), and the lowest frequencies to those born in the second quarter (23%); 2) in the TS of female gymnasts the highest frequencies refer to gymnasts born in the third quarter (27%), and the lowest frequencies to those born in the fourth quarter (23%); 3) in the sample of AAQ male gymnasts the highest frequencies refer to gymnasts born in the first quarter (27%), and the lowest frequencies to those born in the fourth quarter (23%); 4) in the sample of AAQ female gymnasts the highest frequencies refer to gymnasts born in the third quarter (28%), and the lowest

frequencies to those born in the fourth quarter (23%); 5) in the sample of AF male gymnasts the highest frequencies refer to gymnasts born in the fourth quarter (27%), and the lowest frequencies to those born in the second quarter (20%); 6) in the sample of AF female gymnasts the highest frequencies refer to gymnasts born in the first quarter (28%), and the lowest frequencies to those born in the fourth quarter (21%). However, within each group of samples significant differences, between frequencies of OG participants born in a certain quarter of the year, have not been determined. Also, significant differences have not been determined between genders (in all groups of samples) in the frequencies for OG participants born in a certain quarter of the year.

Table 3.
Affiliation of the date of birth for both male and female participants of the Olympic Games held from 1964 to 2016 to a particular half of the year

	TS			AAQ			AF		
	M	**F**	**χ^2 p**	**M**	**F**	**χ^2**	**M**	**F**	**χ^2 p**
N half	**1186**	**1268**	**df=1**	**655**	**1003**	**df=1**	**531**	**265**	**df=1**
1	584	635	0.17 0.68	337	495	0.70 0.40	247	140	2.82 0.09
2	602	633	0.58 0.45	318	508	0.09 0.76	284	125	2.81 0.09
χ^2	0.55	0.01		1.10	0.34		5.15	1.70	
df	1	1		1	1		1	1	
p	0.46	0.94		0.29	0.56		**0.02**	0.19	

Legend: Data are presented as frequencies of male/female gymnasts born in certain half of the year, half – half of the year, M – male gymnasts, F – female gymnasts, χ^2 – Chi square test value, p – level of significance, df – degrees of freedom

By dividing the calendar year into two equal parts (Table 3), different frequencies of male and female participants of all groups born in a certain half of the year have been determined. However, a significant difference between frequencies of participants born in a certain half of the year has been determined only within AF male gymnasts (χ^2=5.15, p=0.02). In this sample of OG participants, higher frequencies of participants were born in the second half of the year compared to frequencies of participants born in the first part of the year. Within all other samples, significant differences between frequencies of OG participants born in certain half of the year have not been determined. Furthermore, significant differences have not been determined between genders (in all observed groups) in the frequencies of OG participants born in half of the year.

DISCUSSION

Analysis of differences between frequencies of gymnasts born in a certain month of the year revealed a disproportion between minimal frequency (74) and maximal frequency (129) and caused significant χ^2 value. However, after reviewing frequencies, it can be seen that three months of the second half of the year have frequencies higher than 100, which eliminates a possible existence of RAE effect.

In traditional investigations of RAE within a year quartile, for obtained results within the men's TS, and consequently within the sample of the men's AAQ as they make up a larger part of male TS, it has been noted that the determination of a higher frequency of male gymnasts had ones born in the first quartile. However, due to

the considerable similarity between the first quartile frequency and frequencies of the other quartiles, a significant difference between them has not been determined, and thus neither the confirmation of the RAE within these groups. Significant difference determined between the men's AF is probably the consequence of a lower frequency in the men's AF determined in the second quartile (n_{Q2}=105) compared to almost equal frequencies in other three quartiles (n_{Q1}=142; n_{Q3}=141; n_{Q4}=143). Accordingly, RAE cannot be confirmed either in this group. The analysis of the frequency of a relative date of birth to a certain half of the year also determined certain numerical differences within the men's TS and men's QAA. Since those differences were not found to be significant, RAE has failed to be confirmed within these groups. Significant differences in the frequency of the men's AF, from which can be seen that a higher frequency of the men's AF was born in the second half of the year compared to frequencies of the men's AF born in the first half of the year, suggests the existence of "reverse" RAE in this sample of gymnasts. From such obtained results it follows that the best male gymnasts, those who have qualified for the apparatus finals at all OG held from 1964 to 2016, were likely to be relatively younger than those who finished their participation at the same OG at somewhat lower levels - in qualification All-Around competitions. Because performing apparatus finals routines, composed from the most difficult elements with the highest technical and aesthetic precision, requires larger amounts of deliberate practice during a longer period of time, then the question about characteristics of gymnasts who have succeeded in overcoming the same arises. Malina et al., (2013) state that the selection of gymnasts generally prefer short, normal, late-maturing individuals while Hancock et al. (2015) explain how gymnasts born in the second half of the year might be slightly less physically mature, resulting in shorter stature, "straighter lines" (leading to increased visual aesthetics), lower weight, and higher strength to body mass ratio than relatively older athletes. Since MAG is all about weight-to-strength ratio, and because those characteristics give biomechanical advantages to gymnasts (Monsma & Malina, 2005), it is logical to conclude that relatively younger athletes might be better suited for talent development and superior gymnastic performance. However, although male gymnasts could, and some of them have participated in the OG at the age of 14 (until 1981), respectively to the age of 15 (from 1981 to 996) and with 16 years (after 1997), from the recent studies it is evident that the average age of all OG participants have been significantly higher from the minimum age requirement (the average age of all male gymnasts participants at the OG, held in the period from 1996 to 2016, ranged from 23.21 years to 25.21 years); and it also referes to all male finalists at the OG held in the period from 1980 to 2016 (average age=23.78; Delaš Kalinski et al., 2017). Results from these studies confirmed how, despite the early start of male gymnasts (Tofler et al., 1996; Arkaev & Suchilin, 2004) the majority of best male gymnasts have experienced expert performances later in a life; especially gymnasts who have qualified for the Ring Finals – apparatus that requires extreme levels of strength (Delaš Kalinski et al., 2017). If results of this study and the study of Delaš Kalinski et al. (2017) are both considered at the same time and through the key factor of success in artistic gymnastics (deliberate practice; Côté & Fraser-Thomas, 2008), the following can be pointed out: 1) a deliberate practice hours in MAG are spread out over a longer timeframe; 2) in the mid or late twenties, as in the case of male gymnasts of the AF, deliberate practice is accompanied by smaller cognitive maturity discrepancies among competitors, because of what deliberate practice can be intensively and equally applied to all; 3) despite the similar or the same amount of deliberate practice probably applied within the men's AF, biomechanical advantages of the relatively younger male gymnasts obviously remain through their entire career

because of what they make majority of the men's AF. Additionally, one of the possible reasons for a majority of relatively younger gymnasts in the men's AF might be a consequence of higher frequency of the dropout rate by the relatively older gymnasts compared to the relatively younger gymnasts (Wattie et al., 2014). All aforementioned facts and results explain the background/reasons of the obtained "opposite" RAE in the sample of gymnasts from the AF.

The obtained results for gymnasts from the men's AF align with the previous studies on artistic sports, whereby it has been suggested that being relatively older is not automatically beneficial (van Rossum, 2006; Wattie et al., 2014; Baker et al., 2014; Hancock, Starke, & Ste-Marie, 2015).

In the sample of female gymnasts, although certain differences between frequencies of all groups have been determined (TS, AAQ, and AF) within months, quarters and halves of the year, significant differences have not found between them. Accordingly, the absence of the RAE was confirmed for this sample of athletes. Since female gymnasts, even as children, have sufficient levels of oestrogen, that enables them to perform structurally complex and energetically-demanding artistic gymnastics skills, but also due to the fear of "disturbing" effects of biological maturation, within female gymnasts deliberate practice starts around the age of 10 (Tofler et al., 1996; Arkaev & Suchilin, 2004). Previous studies confirmed how with the aim of achieving the peak performances/elite levels of performance before adulthood, investing in deliberate practice during childhood and early adolescence becomes vital to success (Côté & Fraser-Thomas, 2008; Côté et al., 2009). Entering puberty, regardless of the exact age at which it occurs (usually around 14.3 years; Anderson, Dallal, & Must, 2003) brings generally the same changes to all female gymnasts. Two facts need to be considered when factors of female gymnasts success are analysed: 1) maturity happens before female gymnasts reach minimum age requirement for participation at the OG; 2) results of the previous studies have shown that the average age of female gymnasts, participants of the OG, have been significantly higher than the prescribed minimum age, especially of those who qualified in the women's AF (Jelaska, Delaš Kalinski, & Crnjak, 2017). Accordingly, it can be assumed that the biomechanical advantages of biologically immature female gymnasts (Monsma & Malina, 2005) and advantages in cognitive maturity of relatively older gymnasts (Baker et al., 2014) have obviously been overcome by female Olympians, because of what the key factors of success at the highest levels of WAG competition in OG need to search for in some other factors. Like at the young age of female gymnast (when achieving of success should be based on deliberate practice; Côté & Gilbert, 2009), in adulthood, the key factor of success is probably the continuation of the deliberate practice. Size of the impact of adulthood deliberate practice among female gymnasts has probably reduced the influence of other factors and has accordingly produced a result of the absence of the RAE in elite WAG.

CONCLUSIONS

Training to becoming an Olympic gymnast can be endured only by athletes with a high level of dedication and persistence during a long period of deliberate practice. Beside deliberate practice, which is the key factor for success for both genders of Olympic gymnasts, morphological advantages of relatively younger male gymnasts might have influence on their participation on the highest levels of gymnastic Olympic competition – participation in apparatus finals. Accordingly, the confirmation of the "opposite" RAE was obtained in the sample of male AF, while RAE failed to be confirmed among and between other samples of examinees.

Structural complexity of artistic gymnastics and longevity of training

processes are probably key factors for reducing negative selection effects due to unpredictable maturation of any other uncontrollable cause.

However, further research is recommended to determine RAE effect between analyzed Olympics, grouped according to time of minimum age requirement changes, with goal to obtain more precise information about RAE in elite artistic gymnastics.

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SHORT HISTORICAL NOTES XIII

Anton Gajdoš, Bratislava, Slovakia & Michal Babela, Faculty of Physical Education and Sports, Bratislava, Slovakia

Ph.D. Anton Gajdoš born on 1.6.1940 in Dubriniči (today Ukraine) lives most of his life in Bratislava (ex TCH, nowadays SVK). He comes from gymnastics family (his brother Pavel have world championship medals) and he devoted his life to gymnastics. His last achievement is establishment of Narodna encyklopedia športu Slovenska (www.sportency.sk). Among his passion is collecting photos and signatures of gymnasts. As we tend to forget old champions and important gymnasts, judges and coaches, we decided to publish part of his archive under title Short historical notes. All information on these pages is from Anton's archives and collected through years.

LEON ŠTUKELJ (* 12.11.1898, Novo Mesto, Slovenia, †8.11.1999, Maribor, Slovenia)

Leon Štukelj, lawyer who graduated at University of Ljubljana, had the first international competition at World Championship in Ljubljana (Slovenia, ex Kingdom of Serbs, Croats and Slovenes) in 1922. At his the first appearance he competed not only on apparatus, but also in swimming and track and field disciplines. At his 1.60 m height and 50 kg weight, his body was not able to achieve good results at shot put, as the ball had 7.25 kg. Similar results were also at other world championships as up to the end of WWII also other disciplines besides apparatus were included.

But on the other hand Olympic Games were just created for Leon. Already at OG in Paris (France) 1924, he won all around title and gold on high bar. His victory in all around was won on vault, where we can still admire his extra ordinary motor abilities. Figure bellow show how split vault for 10 points had to be performed. Gymnast had to jump over line of 1.70 m height (without break it) in the first flight, than support and split jump. For a gymnast it was important to raise his center of body mass close or over 2 meters, and again we have to consider Leon's height was only 1.60 m. His surprise victory had huge impact, he was invited to Finland and Hungary to show his mastership, King of Yugoslavia decorated him with Sv.Sava of V.order. In Slovenia masses were waiting for him at railway stations to congratulate him, in Novo Mesto mayor saluted him with Ave triumphator. For his 100th birthday a remake of this celebration took place in Novo Mesto with collaboration of IOC president Juan Antonio Samaranch and FIG Norbert Bouche.

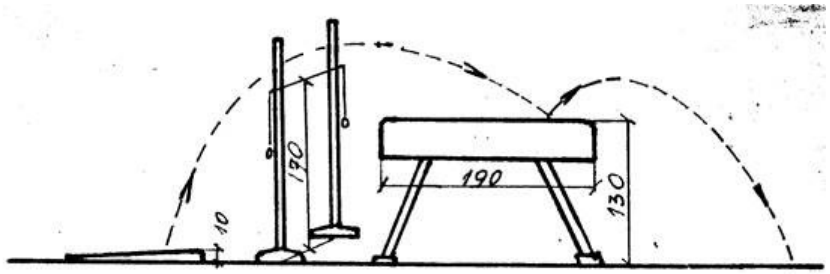
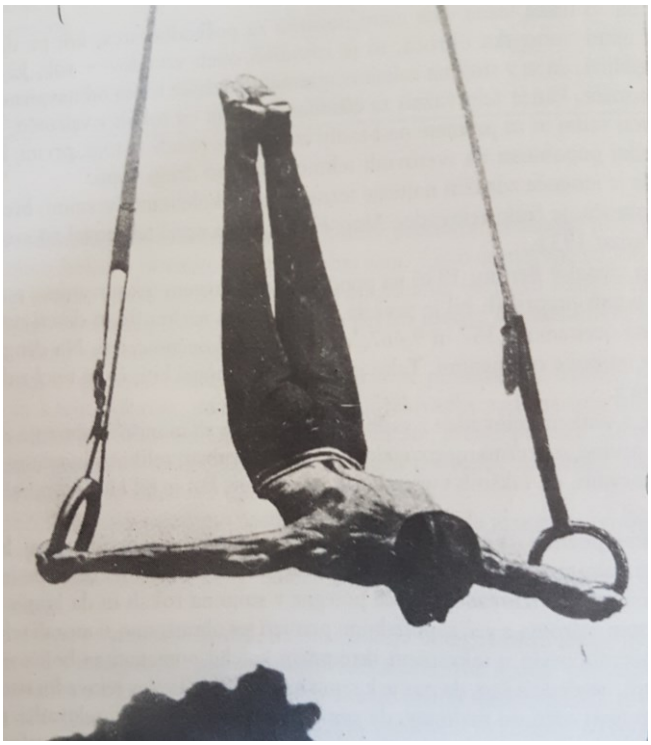


Figure 1. OG 1924, vault apparatus measures. Vazzaz, Gregorka: Razvoj telovadnega orodja na Slovenskem [Development of gymnastics apparatus in Slovenia], Elan, 1984

At OG 1928 in Amsterdam (Netherland) he was excellent again with wining rings, in all around he was the third, and aloso team under dr. Viktor Murnik (father of Slovene gymnastics) placed on the third place. In his book he wrote down, his team took on train parallel bars from Ljubljana to Amsterdam. Whenever they had to change train, they had to carry parallel bars to next train. But it was worth, as showed results.

Yugoslav team did not compete at 1932 OG in Los Angeles (USA) due to lack of money and argues inside Sokol union. Unfortunately, as whole generation of gymnasts under Leon Štukelj leadership was between both WW among top gymnasts in that time.

His last OG were in Berlin (Germany) in 1936, where at his late age for gymnast still managed to place himself on the second place on rings.

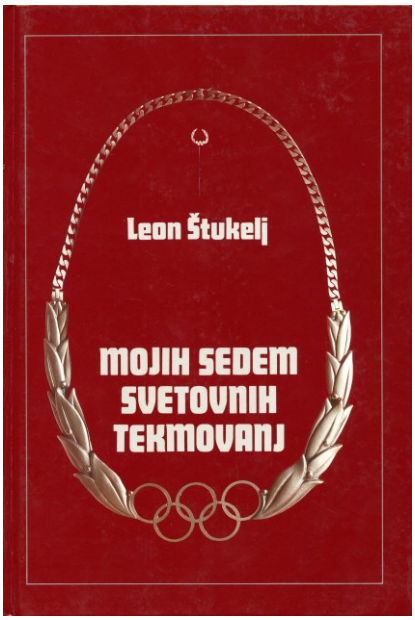


Despite it is not officially it is important to know Leon Štukelj is the first gymnast to perform inverted cross on rings at World Championship or Olympic Games.

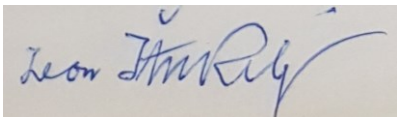
Photo on the left is from Leon Štukelj's book Mojih sedem svetovnih tekmovanj [My seven world competitions].

After the WWII communist regime took him in prison for two years, relased him and degraded him from judge into one unimportant company secretary.

IOC president Juan Antonio Samaranch rewarded him in 1987 at University games in Zagreb (Yugoslavia) and took him out of anonymity and with new state of Slovenia, he again deserved olympic honors. He is with Miroslav Cerar individual founder of Slovene Olympic Committee. His star moments were at Atlanta (USA) 1996 OG opening ceremony where he was introduced as the oldest living Olympic champion.



Leon's book is excellent description of history of gymnastics between WWI and WWII. With lot of photos, the most important are all results from all competitions he competed. From the book we can read, many gymnasts at OG or WC were rewarded with the maximum possible scores e.g. at OG 1924 Zamporini (Italy) on parallel bars, Seguin (France) on vault, Štukelj on rings, just to name some of them.



Leon Štukelj and his OG medals at his home in Maribor (archive and photo Anton Gajdoš)

Slovenski izvlečki / Slovene Abstracts

Maja Pajek

REZULTATI OLIMPIJSKIH ZMAGOVALK MNOGOBOJA NA POSAMEZNIH ORODJIH

Spremembe Pravil za ocenjevanje spodbujajo povečanje težavnosti sestav in vedno več vadbe na posameznem orodju. Razčlenjeni so bili rezultati zmagovalk olimpijskega mnogoboja na posameznih orodjih. Podatki iz olimpijskih iger 1952-1984 kažejo, da so v tem obdobju kar pet krat nosilke medalj v mnogoboju osvojile kar 75 do 100% vseh medalj na posameznih orodjih. Na splošno so na prvih treh obravnavanih olimpijskih igrah nosilke medalj v mnogoboju osvojile 7,7 medalje na zadnjih treh pa 4,3. Uspešnost zmagovalke v mnogoboju je bila izračunana kot vsota vseh odličij na orodjih deljeno s štiri. Število odličij na posameznih orodjih pri olimpijskih zmagovalkah pada in tudi v bodoče je pričakovati tak trend.

Ključne besede: zgodovina, orodna telovadba, razvoj.

Ivan Čuk, Karmen Šibanc

KAKO USPEŠNI SO OLIMPIJSKI ZMAGOVALCI V MNOGOBOJU NA POSAMEZNIH ORODJIH NA OI 1924-2016

Na prvih olimpijskih igrah moderne dobe v Atenah 1896, mnogoboj v orodni telovadbi še ni bila disciplina. Prvič so odličja v mnogoboju podelili leta 1900 v Parizu, vendar do naslednjih olimpijskih iger leta 1924 prav tako v Parizu niso podeljevali odličij na posameznih orodjih. Članek raziskuje kako uspešni so bili olimpijski zmagovalci pri osvajanju odličij na posameznih orodjih. V Parizu leta 1924 je Leon Štukelj osvojil naslov v mnogoboju in na drogu. Od takrat dalje so nosilci odličij v mnogoboju zelo različno osvajali tudi odličja na posameznih orodjih. Zadnji serijski zmagovalec je bil Vitalij Šerbo (Belorus), ki je leta 1992 zmagal v mnogoboju in še na treh orodjih. Od takrat dalje ni nihče ponovil tega uspeha. Z odprtimi Pravili za ocenjevanje , so se odprla vrata posameznikom, ki vadijo in tekmujejo le na enem orodju, prav tako je vedno več takih posameznikov tudi na olimpijskih igrah, zato se možnosti za ponovitev uspeha Vitalija Šerba zmanjšujejo.

Ključne besede: zgodovina, moška tekmovalna orodna telovadba, nosilci odličij.

Ivana Montandon Aleixio, Myrian Nunomura

STAROST IN ŠPORTNA POT PRI ORODNIH TELOVADKAH

Ženska tekmovalna orodna telovadba (WAG) je olimpijski šport, ki je sčasoma ustvaril slavna mlada dekleta, ki so ga obširno kritizirali zaradi "majhnih pikic ". Sedanja raziskava je nastala z načrtom "Staranje: k najboljši praksi ženske orodne telovadbe " (Kerr, Barker-Ruchti, Schubring, Cervin, Nunomura, 2015), ki je bil namenjen razčlenitvi izkušenj starejših telovadk in dejavnikov, kar je prispevalo k podaljšanju njihovih športnih poti. Udeleženke te študije so bile bivše telovadke, ki so še vedno dejavne na Portugalskem na visoki ravni. Izvedli smo polstrukturirane pogovore za zbiranje poročil udeležencev in tematsko razčelnitev smo uporabili kot obdelavo podatkov. Dojemanje, da postanejo telesno starejša, je bilo med večino telovadk najtežje uresničiti. Izkušnje pri "starejših" telovadkah so jim pomagale razumeti, kako se posamezna dejanja zgodijo in se tako soočajo z izzivi novih stopenj njihove športne poti. Dejavniki, ki vplivajo na razvoj kariere, so bili omiliti mit, da zrele ženske v orodni telovadbi ne morejo sodelovati na mednarodni ravni; predlagati nadomestne možnosti za usposabljanje, da se ohrani splošno zdravje telovadk; predlagati smernice za vodenje športne poti. Postavljajo se smernice prihodnjih raziskav o tem, kaj bi bilo mogoče storiti, kaj ne bi smelo biti storjeno; ali česa bi se morali izogibati s vaditelji, telovadke in zainteresiranimi stranmi na splošno za nadaljnjo športno pot telovadk.

Ključne besede: ženska orodna telovadba, telo, podaljšanje športne poti.

William A Sands, Steven R Murray, Jeni R McNeal, Cindy Slater, Michael H Stone

ZGODOVINSKE SPREMEMBE V TELESNI VIŠINI, MASI IN STAROSTI AMERIŠKIH TELOVADK NA OLIMPIJSKIH IGRAH

Skoraj vse sodobne olimpijske igre so prinesle mnoge pripombe in kritike glede telesnih značilnosti telovadk. Pripombe kritikov, znanstvenikov, novinarjev in zdravnikov prepogosto nakazujejo, da so te pomanjšane športnice nenavadno majhne in morda nezdrave. Namen: razširjena in posodobljena razčlenitev telesnih značilnosti ameriških olimpijskih telovadk, vključno z olimpijskimi igrami leta 2012 in 2016. Metode: Ocenjene so bile uradne javne evidence ameriškega olimpijskega komiteja in ameriške telovadne zveze telovadk olimpijske vrste, vključno z višino, maso, starostjo, indeksom telesne mase (BMI) in uvrstitvijo v skupine. Ocenjeno je bilo šestnajst olimpijskih vrst s skupno 123 telovadkami, vključno z njihovimi namestnicami. Analize smeri razvoja smo izvedli z uporabo linearnih in polinomskih modelov. Rezultati: Analize so pokazale, da se je od leta 1956 najprej zmanjšala višina, masa, starost in BMI, nato pa se je povečala, z izjemo višine in ranga. Najboljše regresijske napovedi so bile pridobljene z enačbami polinomov 2. reda. Višina in razvrstitev sta v celotnem zgodovinskem obdobju naraščala. Zaključek: Ženske olimpijske telovadke so se v približno osemdesetih in zgodnjih devetdesetih letih nižale. Do leta 2008 so opazili naraščanja spremenljivk višine. Dodatek podatkov o olimpijskih igrah za leti 2012 in 2016 je pokazal, da se je višina premaknila z manjšim trendom naraščanja in se v zgodovinskem obdobju še naprej zmanjševala.

Ključne besede: smer razvoja, telesne značilnosti, telovadke, velikost.

Flavio Bessi and Jan Pfeifer

SMER VRTENJA PRI OBRATIH NAJBOLJŠIH SVETOVNIH TELOVADKAH

Svetovno najboljši vaditelji sprašujejo, ali obstaja shema vrtenja, ki izboljša učinkovitost pri telovadbi in / ali olajša učenje prvin z obrati. Čeprav obstajajo nekatere raziskave in znanstvene publikacije o tem, še vedno iščemo več podatkov, da bi razumeli podvržene odnose v navadah visokokvalitetnih telovadk. V nedavni študiji so bili finalisti v mnogoboju olimpijskih iger na olimpijskih igrah Rio 2016 kategorizirani z uporabo sedanjega načina razvrščanja smeri obratov. Namen te študije je kategorizirati ženske finalistke mnogoboja na olimpijskih igrah Rio 2016. Poleg tega; bi morala raziskava pomagati izboljšati načina razvrščanja s primerjavo obeh spolov. Predpostavljamo, da bi morala biti shema vrtenja žensk bolj zahtevna zaradi zahtev plesnih gibov in telovadnih obratov. V tem okvirju je namen raziskave, da se oblikuje tudi sistem za razvrščanje telovadk. Študija je pokazala, da se 52% ženskih finalistk obrača na desno, medtem ko se 48% raje obrača na levo pri plesu in telovadbi.

Ključne besede: stranskost, prednost smeri, obrati, doslednost smeri obrata.

Catarina Leandro

TEŽAVNOST PRI RITMIČNIH SESTAVAH MED DVEMA OLIMPIJSKIMA DOBAMA

Namen te študije je bil analizirati razvoj težavnosti posameznih orodij v dveh olimpijskih dobah in ugotoviti morebitne dejavnike, ki bi lahko prispevali k izboljšanju kakovosti izvedbe na tekmovanju. V ritmiki smo raziskovali težavnost prvin z orodjem (morda bi lahko ritmičarke sodelovale na olimpijskih igrah) na prvih svetovnih prvenstvih vsake dobe (2012/2016 in 2016/2020). Ta razčlenitev se je osredotočila na tehnično vrednost prvin, ki so jih izvajale ritmičarke v skupno 288 sestavah na svetovnem prvenstvu leta 2013 in 200 sestavah na svetovnem prvenstvu 2017. Podatki so bili obdelani z opisno statistiko in po preverjanju normalno porazdelitev podatkov z uporabo testa Kolmogorov-Smirnov smo uporabili t-test, da ugotovimo, ali med svetovnimi prvenstvi obstajajo značilne razlike. Rezultati so pokazali naraščajoči pomen težavnosti prvin v končnem rezultatu ritmičark. Prvine težavnosti so se znatno povečale iz ene dobe v drugo, predvsem zaradi povečanja vrednosti mojsterstev. Obstaja večje ravnovesje pri uporabi različnih prvin, kar daje prednost izvedbi. Povečanje vrednosti težavnosti z orodjem v tekmovalnih sestavah bo prispevalo k kakovosti in raznolikosti tekmovanja ritmike na olimpijskih igrah.

Ključne besede: ritmika, težavnost po orodjih, ocenjevanje, tekmovanja, predstavitev.

Eliana Toledo, Mateus Oliveira, Maria Letícia Scarabelim, Bianca Assumpção

VPLIV SPREMEMBE GLASBE V PRAVILNIKU ZA OCENJVENAJE (2013-2016) NA SESTAVE RITMIČARK NA OI 2016

Pravilnik za ocenjevanje v ritmiki 2013-2016, je bil mejnik, ki omogoča vokalno glasbo v sestavah. Namen te študije je bil razčleniti vpliv te spremembe v sestavah na olimpijskih igrah leta 2016 v Riu (Brazilija). To je dokumentarna raziskava z dvema vrstama virov: uradnim virom mednarodne telovadne zveze in videoposnetki sestav. Vzorec je sestavljalo 26 ritmičark in 14 vrst. Razvrstitev je bila količinska in kakovostna (vrsta glasbe). Ugotovili smo, da je bilo od 104 pesmi posameznih sestav, 81 pesmi samo z glasbili (IM) in 23 predstavljenih z glasom in besedami (MVW). Med IM je bilo 21 severnoameriških (NA) in 60 iz drugih narodnosti (ON). Med MVW je bilo 11 NA in 12 od ON. V sestavah vrst je bilo od 28 pesmi, 17 IM, 11 pa MVW. Od IM jih je bilo 6 NA in 11 ON. Med MVW je bilo 6 NA in 5 ON. Sklepamo, da je večina posameznic in vrst uporabila to novo pravilo. Ta sprememba je bila dejansko vključena v programe nacionalnih zveze in ugotovili smo močan vpliv NA glasbe.

Ključne besede: ritmika, olimpijske igre, Pravila za ocenjevanje, Severno Ameriška glasba.

Laurita Marconi Schiavon, Bruna Locci

POGLED BRAZILSKIH TELOVADK NA NJIHOVO UDELEŽBO NA OLIMPIJSKIH IGRAH

Ta članek razčlenjuje pogled brazilskih telovadk, ki so sodelovale na olimpijskih igrah (OG) v orodni telovadbi (WAG) (1980-2004), o izkušnjah, ki uporabljajo ustno zgodovino v kvalitativnem raziskovalnem pristopu in medsebojno tematsko razčlenitev. Avtorica se je pogovarjala z desetimi brazilskimi telovadkami (100% vzorca), ki so sodelovali na OG do leta 2004. Pričevanja telovadk so pokazala, da se je brazilska skupina WAG izboljšala na mednarodnih tekmovanjih, pričakovanja telovadk so se sčasoma spremenila, sanje, da sodelujejo na OG, so jih vsi delili. Od generacije pionirskih telovadk (1984-1988-1992) do prehodne generacije (1996-2000) je mogoče opaziti več razlik, povezanih s pritiskom, da se dobro uvrstijo na tekmovanju. Medtem ko pionirske telovadke niso bili zaskrbljeni glede njihove uvrstitve na OG, so bile prehodne telovadke opozorjene na odgovornost, da zastopajo svojo državo. Za nove generacije telovadk (2004) je udeležba na OG nosila breme, da bi morali nekaj doseči, da bi bile med najboljšimi telovadkami na svetu, z dejanskimi možnostmi, da bi odšle v finale in dobile medalje v finalih na orodjih. Pričevanja kažejo njihovo zaupanje v delo, ki so ga razvili izkušeni ukrajinski trenerji, ki so vodili brazilsko ekipo na OG v Atenah. Telovadke opisujejo svoje izkušnje na OG, ker so opravili poslanstvo, obenem pa občutek olajšanja, razočaranja, želje po vrnitvi na druge igre, nekatere celo poročajo o občutku izgubljenosti po vrnitvi v Brazilijo.

Ključne besede: ženska orodna telovadba, zgodovina, olimpijske igre.

Caroline Inácio Molinari, Vitor Ricci Costa, Kamau Osei Fregonesi Ferreira Monteiro, Myrian Nunomura

KRITIČNA RAZČLENITEV NASTOPOV BRAZILSKIH TELOVADK NA OLIMPIJSKIH IGRAH V OBDOBJU 2004-2016

Ženska orodna telovadba (WAG) v Braziliji je bila zastopana na olimpijskih igrah od leta 1980; vendar pa je bila polna vrsta uvrščena šele leta 2004. Razčlenili smo udeležbo brazilske vrste v zadnjih štirih obdobjih (2004-2016), in smo ugotovili več dejavnikov, ki so bili podani v rezultatih WAG. V študiji smo ocenili te dejavnike, ki so odrazili na njihovih prispevkih k razvoju orodne telovadbe. Mejnik olimpijskega obdobja 2001-2004 zaznamuje prva udeležba celotne vrste, ko so tuji vaditelji prevzeli WAG, sistem usposabljanja je bil reorganiziran in izbrani športniki so se začeli vaditi v centraliziranem okolju usposabljanja v Curitibinem centru za usposabljanje. Obdobje 2005-2008 je bilo uspešnejše, kot posledica dolgoročnega načrtovanja. V olimpijskem obdobju 2009-2012 je brazilski WAG šel skozi obdobje turbulence, usposabljanje ni bilo več centralizirano, glavni vaditelj brazilske vrste se je vrnil v svojo matično državo. V olimpijskem obdobju 2013-2016, z organizacijo olimpijskih iger 2016 v mestu Rio de Janeiro, je brazilski olimpijski komite izdelal strategije za povečanje uspeha države, kar je spet prineslo izboljšanje rezultatov vrste. Zaključili smo, da so zadnja olimpijska obdobja predstavljali velik napredek v brazilski WAG. Prestrukturiranje od leta 2000 je bil najpomembnejši pogoj, da bi disciplina dosegla sedanjo raven. Izboljšanje pogojev usposabljanja in konkurence, strukturiranje Centra za usposabljanje odličnosti in podpora multidisciplinarnih vrst so bili bistveni za pripravo brazilske vrste na olimpijskih igrah.

Ključne besede: olimpijske igre, večletno načrtovanje, mednarodna zahvala.

Marco Bortoleto, Paulo Carrara, Murilo Guarniei Roveri

SKOKI NA PONJAVI: BRAZISLKA UDELEŽBA NA VELIKIH TEKMOVANJIH – UDELEŽBA NA OLIMPIJKSIH IGRAH ŠE VEDNO SEN

Od kar sta sodobno ponjavo zgradila George Nissen in Larry Griswold okoli leta 1934 v ZDA, je ta oprema in njegova uporaba doživela velike spremembe. Njen razvoj je bil odločilen, da bi se skoki na ponjavi vključili v program olimpijskih iger leta 2000. V Braziliji se je ta šport prčel v osemdesetih letih in je bil vključen samo v brazilsko telovadno zvezo leta 1999. Namen študije je razčleniti brazilsko udeležba na mednarodnih prvenstvih skok na ponjavi. Zbiranje podatkov je potekalo z zbiranjem dokumentov z glavnih mednarodnih tekmovanj. Rezultati kažejo, da je bila prva udeležba na olimpijskih igrah za Brazilijo mogoča šele leta 2016, saj je Brazilija država gostiteljica, čeprav je Brazilija vodilna v Južni Ameriki z ustreznim sodelovanjem na celinski ravni. Sklepamo, da brazilska udeležba na svetovnem prvenstvu in na olimpijskih igrah ni pomembna. Nenazadnje tudi pomanjkanje ustrezne opreme, slabo stanje centrov za usposabljanje, odsotnost rednih in uradnih programov vaditeljskega izobraževanja in pomanjkanje podpore društvom kažejo, da ta disciplina telovadbe ni prednostna naloga nacionalnih športnih organov.

Ključne besede: telovadba, olimpijske igre, tekmovanje, razvoj.

William Sands, Olyvia Donti

ZGODOVINSKI PREGLED USPEŠNOSTI AMERIŠKIH TELOVADK NA SVETOVNIH PRVENSTVIH IN OLIMPIJSKIH IGRAH 1936 - 2016

Ženska vrsta telovadk iz ZDA je v zadnjih letih izjemno nastopila na olimpijskih in svetovnih prvenstvih. Eden od vidikov uspešnosti, ki je bil pomemben pri uvrstitvi vrst, je predhodna izkušnja športnikov. Predhodne izkušnje lahko merimo s skupnim številom tekmovanj na svetovni ravni in trajanjem športne poti pred danim tekmovanjem. Olimpijske igre in svetovna prvenstva so bili pregledani med letoma 1936 in 2016. Število tekmovanj na tekmovalko in rezultati vrste so bili razčlenjeni za celotno obdobje. Bilo je 193 telovadk in 43 tekmovanj. Športna pot trajanja telovadke je bila določena z izračunom let med tekmovanji, v katerih je sodelovala. Rezultati regresijske razčlenitve časovnih serij niso pokazali nikakršne zveze med trajanjem športne poti in obdobjem, medtem ko je bil s časoma značilen trend zmanjševanja ranga vrste (boljši zaključek ekipe). Po razdelitvi obdobja na dva dela ni bilo nobenih značilnih razlik med zgodnjim in poznim obdobjem v trajanju športne poti, statistične razlike v razvrstitvi vrste pa so bile enake v enakem obdobju. Olimpijske igre in svetovna prvenstva so bila ločena in spet ni bilo nobenih značilnih razlik med dvema stopnjama tekmovanja glede trajanja športne poti, niti ni bilo v obeh obdobjih razvidno značilno razlikovanje. Zdi se, da ni bilo razmerja med trajanjem kariere in uvrstitvami vrst.

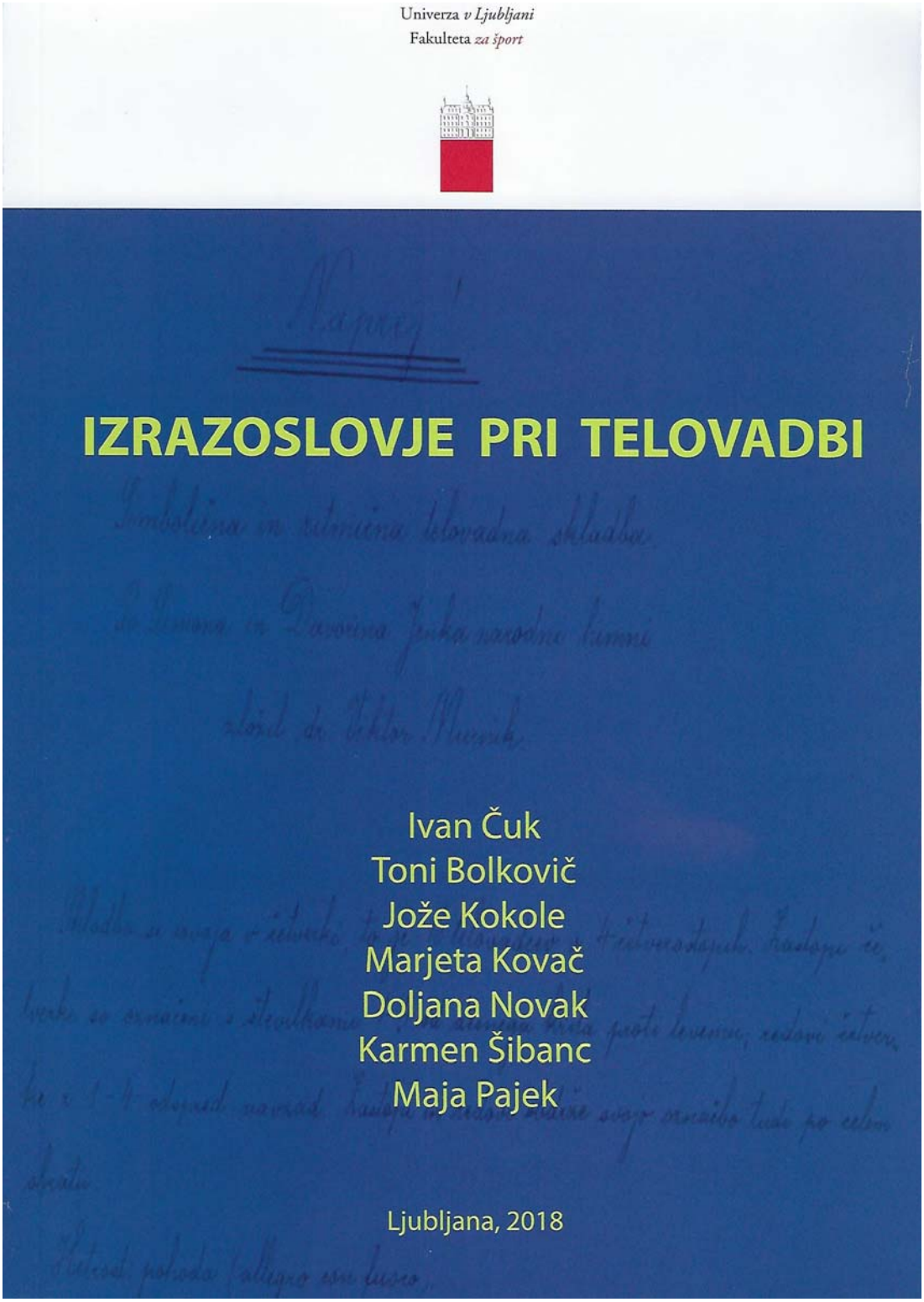
Ključne besede: zgodovina, razvoj, posameznice, vrste, mednarodni nivo.

Sunčica Delaš Kalinski, Petra Mandić Jelaska, Almir Atiković

VPLIV SORAZMERNE STAROSTI NA OLIMPIJSKE TELOVADCE

Sorazmerni starostni učinek (RAE) je svetovni pojav, ki je opisan kot posledica starostnih razlik med posamezniki, ki tekmujejo v isti skupini. RAE temelji na določilu, ki 1. januar uporabljajo kot mejni datum, in se uporablja za zmanjšanje razvojnih razlike med starostmi in zagotoviti bolj pravično tekmovalnost. Prej smo v orodni telovadbi večino študij na RAE opravili pri telovadcih na državni ravni. Ta študija je razčlenila RAE tako med vrhunskimi telovadkami (NF = 1268) in telovadci (NM = 1186), ki so sodelovali na vseh olimpijskih igrah, ki so potekale od leta 1964 do leta 2016. Z uporabo $\chi 2$ testa smo ugotovili pomembno razliko: 1) v količini skupnega vzorca telovadcev, rojenih v določenem mesecu ($p < 0,001$); 2) v količini v vzorcu finalistov na orodjih, rojenih v določenem mesecu ($p < 0,005$); 3) v količini v vzorcu finalistov na posameznem orodju, rojenih v določenem četrtletju leta ($p < 0,005$); 4), v količini v vzorcu finalistov na posameznem orodju, rojenih v določeni polovici leta ($p < 0,005$). Kar se tiče telovadk, v količinah katerekoli ženske skupine, rojene v določenem mesecu, četrtletju ali polovici leta, ni bilo ugotovljenih pomembnih razlik. Glede razlik med spoloma niso bile ugotovljene nobene pomembne razlike med frekvencami telovadcev in telovadk, rojenih v določenem mesecu, četrtletju in polovici leta. Kljub določenim razlikam med spoloma je bil splošen sklep, da RAE ni prisoten pri vrhunskih telovadcih in telovadkah.

Ključne besede: moški, ženske, razlike, starost.



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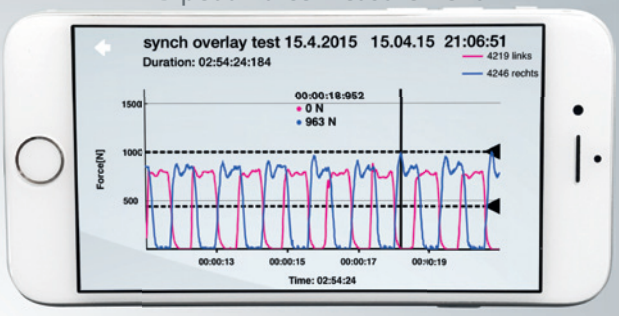

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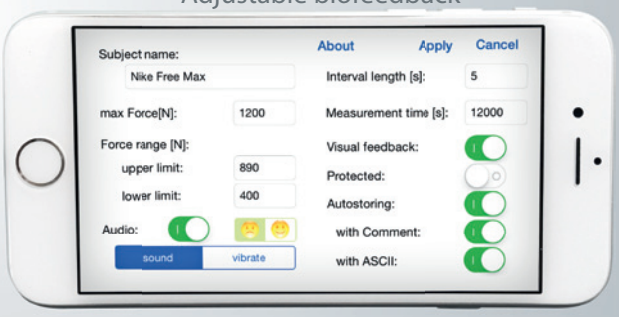

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