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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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).

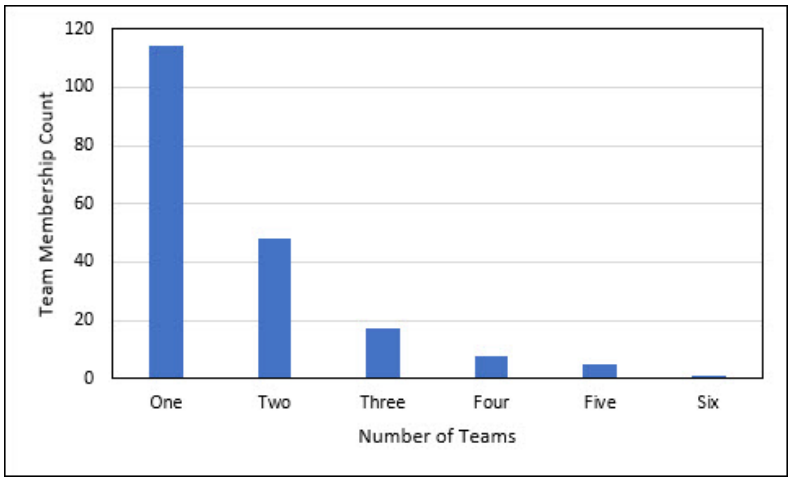

Figure 1. Distribution of the number of competitions attended by USA women's gymnasts.

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, $p > 0.05$).

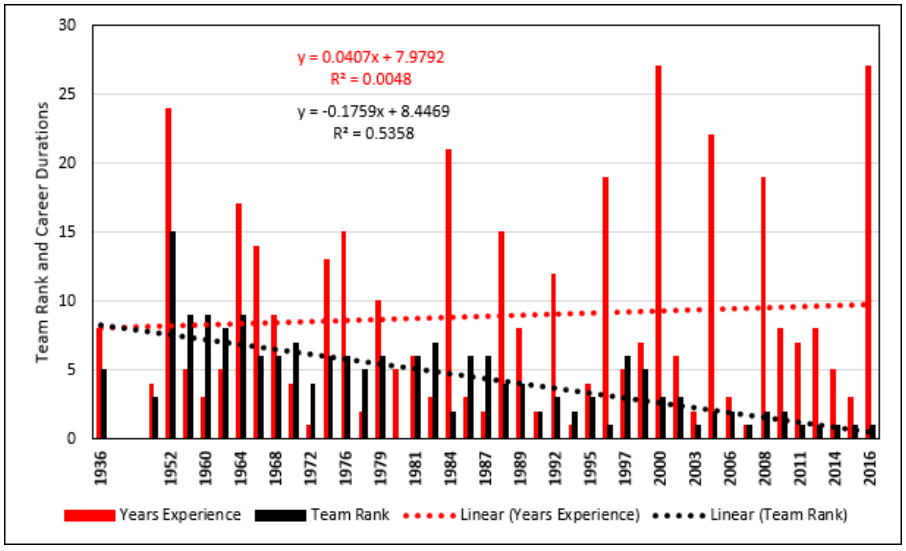

Figure 2. Linear regression analysis of athlete careers and team ranks. The time gap between 1936 and 1948 is the period of the second world war during which no Olympics or World Championships competitions were held.

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).

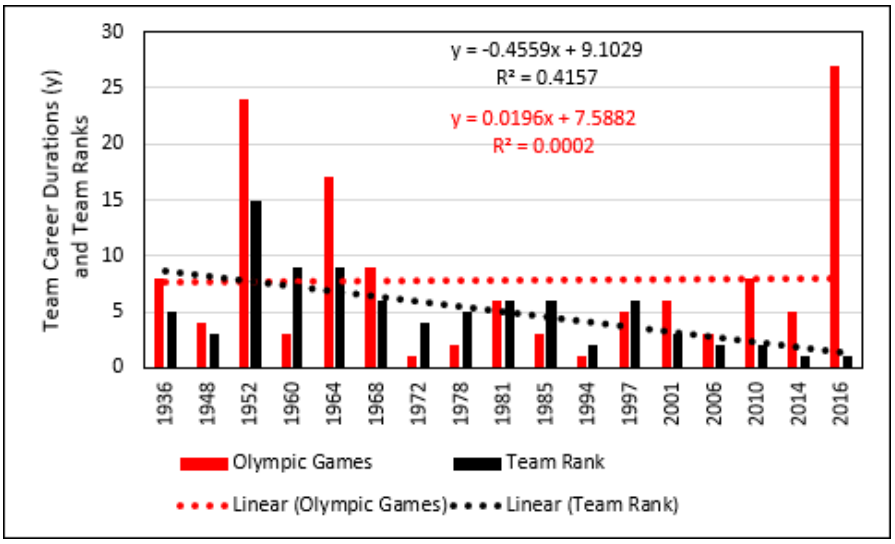

Figure 3. Olympic Games trends of career durations and team ranks.

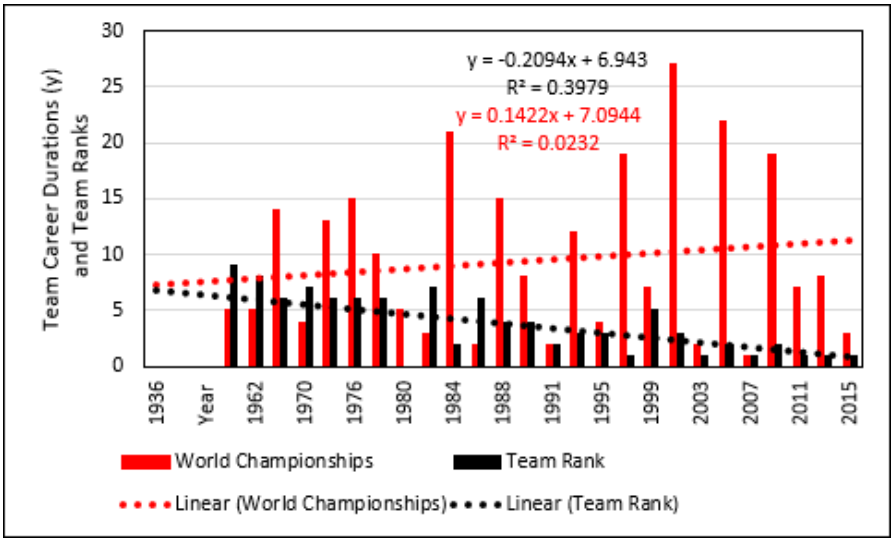

Figure 4. World Championships trends of career durations and team ranks.

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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