

Evaluation and Discussion of Post-COVID Higher-Rated Women's Teams Winning More Often and Men's Teams Less Often in World Championships

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A pre-COVID 2007-2019 data base was gathered to study all team sports that had international recognition, had an official rating system published by the governing federation and had a world championship (WC). The data base included 40 WCs for the 13 men's team sports, 35 WCs for the 12 women's team sports and a total of 3936 games in which the percentage of games won by each higher-rated team was tabulated. The higher-rated women's teams won only 0.25% more than the men's teams. Post-COVID, nine WCs were contested during 2021 and 2022, along with one in 2023, using the same rating system as pre-COVID: four for men and five for women. In all four of the men's WCs, the percentage of games won by the higher-rated team was lower post-COVID: curling (-6.1%), rugby 7s (-12.9%) and T20 cricket (-10.9% and -6.9%). However, the women's higher-rated teams had higher percentages of games won in all five WCs post-COVID: curling (+7.3%), rugby 7s (+6.2%), T20 cricket (+7.0%), basketball (+5.0%) and rugby union (+0.4%). During the COVID-era restrictions, women's social cohesiveness drove increased team cohesiveness creating increased cooperative learning and execution of tactical skills, whereas men emerged with less team cohesiveness.

Keywords: *sports predictions, gender differences, team cohesiveness, post-COVID changes*

Introduction

International sports competition suffered severe disruptions in 2020 due to the COVID-19 epidemic. The number of international cancellations, delays in competition and restrictions on training were reminiscent of the devastating effects of World War 2 and of the Cold War. That analogy is highly appropriate since a war was being waged, in that case upon a disease. The goal of this paper is to build upon a sizeable, previously created, data base of sports, rating systems and predictive evaluations to choose appropriate post-COVID results that permit a relative evaluation of how women and men performed post-COVID compared to pre-COVID and to then to discuss the differences.

Stefani (2011) covered significant sports and their rating systems, beginning with an objective selection of significant world sports as recognized internationally. One recognition source was the International Olympic Committee (IOC) which lists sports for inclusion in the summer and winter Olympics in IOC (2023a), with a link to IOC-recognized sports that are thereby eligible for future Olympics in

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IOC (2023b). Sport Accord, also called the General Association of International Sports Federations (GAISF), was a second source of recognized sports. Sport Accord recognized all the IOC sports and several others for which it formerly organized world competition. Sport Accord disbanded in late 2022; but fortunately, its formerly-recognized sports are included in Stefani (2011) and are also included in Wikipedia (2023), along with IOC sports and several others. Wikipedia (2023) also includes handicapped sports which are not included herein. Finally, Stefani (2011) included other sports listed in that Wikipedia link for other widely played international sports.

Stefani (2011) included official rating systems published by the international federations of the recognized sports. In that way, each rating system as published was created to enhance each sport and with full agreement with all stakeholders in each sport.

Stefani (2011) discussed the sports and their rating systems. Since the IOC recognizes the federations that organise chess and bridge, by definition, those federations become sports federations and chess and bridge become sports, requiring a new terminology, mind sports. In combat sports such as wrestling and boxing, one person tries to physically overcome the other and where winning and rating systems are subjective. At the opposite extreme are independent sports such as running and swimming where athletes are not to impede the other. Ratings are usually based on the best yearly performances.

The remaining sports involve contesting for an object such as in baseball, rugby and basketball. There are two types of objective team rating systems, accumulative and adjustive. In an accumulative system

$$\text{Rating} = \sum f_i(\text{results, importance, ageing}) \quad (1)$$

Each f_i is ≥ 0 so the result is a non-decreasing accumulated running sum over the time period in years of each accumulative system. The points depend on the final position in a competition, the importance of that competition and how long ago each competition happened. The points generally do not depend game-by-game on each opponent competed against.

In contrast, an adjustive rating system, as the name implies, adjusts after each game as follows:

$$\text{New Rating} = \text{Old Rating} + K (\text{Actual} - \text{Expected}) \quad (2)$$

A rating can adjust depending on factors such as home advantage, opponent rating, rating difference, score difference and match importance. Clearly an adjustive system is sensitive to much more information than is an accumulative system and it adjusts more strongly due to recent results than for an accumulative system.

The remaining sections of this paper cover the pre-COVID work on predictive accuracy as summarized in Stefani (2023), the corresponding selection of sports for which to compare post-COVID values with pre-COVID values and a discussion of those results.

Pre-COVID Sports Predictability

Having created the list of significant world sports and the list of official sports federation rating systems in Stefani (2011), attention turned to understanding the predictive accuracy of the rating systems, defined as the fraction of games won by the higher rated team, excluding draws, so that sports like soccer football that have many draws would not immediately have lower predictability compared to sports without draws. Before 2020, the year when the COVID-19 epidemic had its major effect, the data base included 173 recognized international sports. The IOC recognized 128 sports: 47 in the summer Olympics, 15 in the winter Olympics and another 66 significant world sports that could achieve Olympic status. Sport Accord recognized another 19 sports and 26 more widely played sports were found in the then version of the link in Wikipedia (2023). Of those 173 sports, 113 sports federations published an official rating.

Different types of sports categories would need to be evaluated separately, which was beyond the scope of the study. The four non-physical mind sports were not evaluated. The 10 subjectively scored and subjectively rated combat sports were not considered because the other rating systems were objective. The 60 independent sports like swimming and running were not used, because otherwise, rank-ordered competition would have to be compared to rank-ordered ratings, which could not easily be compared to the percentage of higher-rated teams winning games. There remained 39 sports involving the use of an object, such as tennis, badminton, basketball, and rugby. Of them, sports like tennis and badminton were predominantly individual sports while cooperative team activity was involved in basketball and rugby. The 21 non-cooperative team sports were eliminated leaving 18 cooperative team spots. Of those 18, 5 had no world championship, leaving 13 sports. Cricket was then counted twice, due to having both ODI and T20 world championships, creating Table 1, a 14-sport table of world championships: 11 contested by men and women, 2 by men only and one by women only, resulting in 13 world championships for men and 12 for women.

Table 2 shows that 75 world championships were evaluated pre-COVID, using 3936 games. The championships were mostly contested from 2007 to 2019 with one contested in 2020 before major COVID-19 shutdowns. The percentages of wins by the higher-rated teams were separately calculated for the group phase, the knockout phase and overall. In the group phase, teams play each other in a group with the higher performing teams moving to the knockout phase where each loss usually eliminates the loser until the top four positions were determined. Some world championships allow defeated teams to move on to establish classifications other than just first through fourth.

Table 1. 14 Team Sports, 13 Contested by Men and 12 by Women, with 15 Sport-Rating Combinations Due to Soccer

Men and Women (11)	Men Only (2)	Women Only (1)
Basketball	Cricket (ODI)	Netball
Cricket (T20)	Rugby League	
Curling		
Field Hockey		
Football (Soccer) (Two Rating Systems)		
Handball		
Ice Hockey		
Rugby 7s		
Rugby Union		
Volleyball		
Water Polo		

Table 2. Database for the 14 Pre-COVID Team Sports in Table 1 (2007 to 2019 plus 1 in 2020)

Gender	Sports	Competitions	Games
Men	13	40	2245
Women	12	35	1691
Total	25	75	3936

To simplify the presentation of predictabilities, Table 3 shows the overall predictability with men and women's predictabilities combined where possible as per Table 1, creating 15 sport-rating combinations. Six sports used adjustive ratings while the other 9 used accumulative ratings. The highest 6 predictabilities are separated to emphasize the accuracy of adjustive rating systems. Five of the highest 6 are for adjustive ratings and 8 of the lowest 9 are for accumulative ratings. Only one accumulative-rated sport scored in the highest 6, water polo. Only one adjustive-rated sport scored in the lowest 9, men's football.

Table 3. Predictability of the 15 Sport-Rating Combinations from Table 1

Position	Sport (M/W)	WCs	Rating System	Predictability (%)
1	Netball (W)	6	Adj	87.4
2	Rugby Union (M,W)	4,2	Adj	85.8
3	Football (W)	4	Adj	81.5
4	Water Polo (M,W)	2,2	Acc	80.6
5	Cricket (ODI) (M)	4	Adj	79.6
6	Cricket T20 (M,W)	2,1	Adj	78.2
7	Rugby 7s (M,W)	2,2	Acc	75.8
8	Volleyball (M,W)	3,3	Acc	75.0
9	Basketball (M,W)	3,2	Acc	74.7
10	Field Hockey (M,W)	3,3	Acc	73.2
11	Ice Hockey (M,W)	5,5	Acc	73.2
12	Handball (M,W)	3,2	Acc	72.5
13	Rugby League (M)	3	Acc	72.2
14	Football (M)	3	Adj	72.0
15	Curling (M,W)	3,3	Acc	66.9

A regression analysis was performed using the 75 world championship predictabilities as the dependent variable while using 8 independent variables, each identified by 1 indicating presence and 0 indicating absence, causing each regression coefficient to be expressed as a percentage increase (plus) or decrease (negative) to the intercept value. The intercept value was 79.3%. Positive coefficients were observed for women (only 0.25%, so little gender difference was observed pre-COVID), for sports with 7 or less athletes (2.6%), for invasion sports (3.5%) and for substitutes returning (5.4%). Negative coefficients were observed for using an accumulative rating system (-10.9%), for space-restricted indoor and pool sports (-3.4%), and for sports with goalkeepers (-3.9%). When the knockout phase included classification matches for teams who would normally have been eliminated, the group phase coefficient was +4.7% while the knockout phase value was -3.0%. Organizers thus get more consistent play out of all teams trying to move toward higher classification possibilities while in the group phase and closer pairings in the knockout phase leading to less predictable outcomes than with the usual deletion of losing teams.

The information above provides guidance for selecting post-COVID competitions for meaningful comparisons to pre-COVID predictabilities. We know that the adjustive rating systems are much more accurate than the accumulative systems and that small differences in predictability exist for various sports due to competitive conditions. To make meaningful post-COVID comparisons for each gender, the comparisons must be made for the same sport with the same rating system as used pre-COVID. During the COVID period of 2020, some sports changed rating systems and thus cannot be used post-COVID. The two sports in Table 1 that were for men only introduced women's competition, but no pre-COVID values exist. The resulting nine comparisons are now discussed.

Post-COVID versus Pre-COVID Comparisons

Table 4 contains the 9 post-COVID versus pre-COVID comparisons, selected as per the pre-COVID analyses. World championships are included for 2021, 2022 and one that was early enough in 2023 to still have been affected by COVID era disruptions. Five comparisons are for women and four are for men. Three competitions were delayed for one year. For example, the notation 2021/22 means that competition was delayed from 2021 until 2022.

Table 4. *Post-COVID versus Pre-COVID Percentage of Wins by Higher-Rated Teams (Years are Shown for Accumulative Systems)*

Sport	Rating System	Pre-COVID			Post-COVID			Change (%)	
		Years	G	%	Year	G	%	M	W
Curling (M)	Acc(6)	3	214	71.0	2021	97	64.9	-6.1	
Curling (W)	Acc(6)	3	215	62.8	2021	97	70.1		+7.3
Rugby 7s (M)	Acc(1)	2	108	76.4	2022	52	63.5	-12.9	
Rugby 7s (W)	Acc(1)	2	74	75.0	2022	32	81.2		+6.2
Cricket T20 (M)	Adj	2	69	77.6	2020/21	45	66.7	-10.9	
Cricket T20 (M)	Adj	2	69	77.6	2021/22	45	70.7	-6.9	
Cricket T20 (W)	Adj	1	23	80.0	2023	23	87.0		+7.0
Basketball (W)	Acc(8)	2	80	75.0	2022	40	80.0		+5.0
Rugby Union (W)	Adj	2	60	88.1	2021/22	26	88.5		+0.4

Two of the five sports, curling and cricket, require careful tactical decision making followed by skillful action. The other three sports, rugby 7s, basketball and rugby union, are invasion sports requiring instant reactions and strong physical interactions among the players. That is a meaningful breadth of coverage.

For pre-COVID curling, higher-seeded men were 8.2% more predictable than women, but post-COVID men become 6.1% less predictable while women became 7.3% more predictable. For rugby 7s, higher-seeded men were only slightly ahead of women by 1.4% pre-COVID, but lost 12.9% of their predictability post-COVID while women gained 6.2%.

T20 cricket provides three comparisons, two for men and one for women. Pre-COVID women were the more predictable by 2.4%. Men were 10.9% less predictable in their first post-COVID competition, followed by being 6.9% less predictive in their second post-COVID WC, a movement of 4% towards their pre-COVID value. It will be interesting to see if later world championships will show similar movement towards pre-COVID values for the other competitions. Women gained 7.0% post-COVID.

The last two comparisons are for basketball where women gained 5.0% and for rugby union where women gained 0.4%. While 0.4% is much less than their other gains, the pre-COVID predictability was 88.1%, the highest among the 13 men's sports and 12 women's sports. The fact that women could increase predictability at all while approaching 90% is noteworthy.

In summary, higher-seeded men's teams lost predictiveness in all four of their post-COVID competitions while women gained in all five of theirs. The sports are varied and the pre-COVID male-female differences are also varied, providing a wide context for the female-male differential results. In the next section we seek to

understand what differences in activities by the men and women during the war on COVID are consistent with the results.

Discussion

During 2020 when COVID-19 was rampant, athletes were deprived of practice time and of full team activity. We examine the literature regarding effective training to maintain physical and tactical skills while having to train in smaller numbers. It is particularly important to identify methodologies that would be consistent with the differential post-COVID percentage of wins earned by higher-seeded men's and women's teams.

In rugby union, training for defense and for tackling can be attained by small groups of players who work on head position and proper tackle leg drive, depending on playing situation (Sewry et al. 2015). A study with youth rugby league players showed that technical skills may be improved by modifying the number of players experiencing various game situations (Morley et al. 2016). In that methodology, small numbers of players can gain skills that will aid them when full playing conditions return.

For rugby league, training for explosiveness on contact and leg drive on contact can increase tackling effectiveness (Tierney et al. 2018). That training can be achieved with small numbers of players. Elite female netball and volleyball players improved their vertical jump clearances by improving their force-velocity profiles while executing loaded and unloaded counter-movement jumps (Petridis et al. 2021). Although that training was intended for netball and volleyball, the same training could aid various required movements in other team sports.

When youth academy soccer players engaged in small-sided games, their faster-than-normal activity mimicked the faster pace shown by older, professional players (da Costa and Silvino 2023). When professional players had to follow an online training regimen during severe COVID-19 restrictions, they maintained their previous physical testing levels (Anderson et al. 2023).

Although the above studies show that physical strength and individual skill can be retained and even enhanced by women and men training in the smaller groups that would have been seen during COVID-19 restrictions, these drills would not retain the same level of coordinated team performances that higher-rated teams had acquired pre-COVID. Higher-rated women's and men's teams would both be expected to lose more games post-COVID, which is not consistent with Table 4. Instead of physical training, we now examine psychological effects.

Comprehensive questionnaires were given to 400 young soccer players of various ages. Their indicated psychological attributes were compared with their sports abilities. Those athletes that indicated that they possessed personal integrity such as honesty and responsibility also demonstrated social cohesion which linked to what was called task cohesion, meaning team cohesion in this case (Berengui et al. 2022). It was expected that team cohesion would continue as athletes aged and continued to take part in sports. For elite college athletes in basketball and soccer,

increased team cohesion was found to correlate with increased team success, (Carron et al. 2002).

Eyes and Kim (2017) reviewed 30 years of research which dealt with various aspects of cohesiveness, the underlying psychological attributes, and the effects on team performance. In soccer, netball and other sports studied, it was shown that increased team cohesiveness linked with greater team success. The authors formed a panel of 22 coaches each of whom had extensive experience coaching both men and women in various countries and sports. The coaches believed that cohesiveness was more important to women than to men. They also agreed from their experiences, that while it was true that there is a link between team cohesiveness and team success, that relationship was different for women and men. Their opinion was that for women, increased team cohesiveness drove greater team success, while for men, increased team success drove greater team cohesiveness. That observation is consistent with the results in Table 4.

Consistent with the studies above, the onset of many COVID-induced disruptions to their sports would have caused women to be increasingly sensitive to the turmoil of their teammates. Their sense of responsibility and friendship would have moved them to greater levels of social cohesiveness, leading to greater team cohesiveness as condition got worse. That increased team cohesiveness would improve the team's level of play, especially for higher-rated teams. That scenario is consistent with the increased post-COVID fraction of games won by higher-rated women's team in all five of their sports in Table 4. According to the coaches' experiences, the COVID-induced compromised quality of team play would likely have reduced men's team cohesiveness, consistent with post-COVID higher-rated men's teams winning less often in all four of their sports in Table 4.

Conclusions

The higher-rated women's teams in all five of the carefully-chosen and widely-variable post-COVID sports won more games than pre-COVID, likely due to greater team cohesiveness than pre-COVID while higher-rated men's teams won less often in all four of their sports, likely due to reduced team cohesiveness enhancing the detrimental restrictions imposed by anti-COVID activities. These conclusions suggest that coaches in team sports should not only train athletes to develop physical strength and tactical skill, they ought also to create social cohesiveness. An associated increase in team cohesiveness can improve team play, while it can also improve the enjoyment of the players in competition, out of competition and as they look back on their sports experiences in the years to come.

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