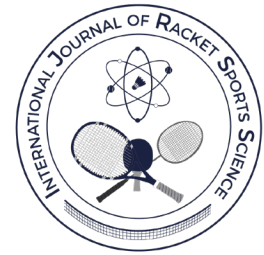# Factors that contribute to winning medals in international soft tennis events

Factores que contribuyen a la obtención de medallas en eventos internacionales de tenis suave

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Abstract

Soft tennis has four major international events, and to date, 29 official international events have been held. During this period, 576 medals have been awarded. In this study, a two-stage analysis was conducted to explore the factors that contribute to the awarding of medals. Due to the highly skewed distribution of medals, decision tree induction was employed. First, five potential variables were examined for the 10 countries that have experienced medal awards. The results showed that the "Host" effect is not a factor for winning medals, but just a norm of international soft tennis events due to the data bias caused by the extreme concentration of host countries among top four. On the other hand, we found that participation in at least 16 international events is necessary to win a medal. An interesting result for Chinese Taipei (CTP) was found that whether the court surface type is "Hard" or not was a contributing factor for winning more medals. In the second step, we examined the distribution of gold medals for the top four countries which have experienced gold medal awards. The results showed that South Korea (KOR) has won more gold medals on clay courts, and CTP on hard courts than the other courts, respectively. This study determines the effect of court surfaces on winning medals at a national level. It was also found that KOR has won more gold medals at the World Championships and Asian Games than at the other international events. Japan, on the other hand, has won more gold medals at the Asian Championships.

Keywords: *soft tennis, international event, medal winning, decision tree.*

Resumen

El tenis suave tiene cuatro eventos internacionales principales, y hasta la fecha, se han celebrado 29 eventos internacionales oficiales. Durante este periodo, se han concedido 576 medallas. En este estudio se realizó un análisis en dos etapas para explorar los factores que contribuyen a la consecución de medallas. Debido a la distribución altamente sesgada de las medallas, se empleó la inducción de árboles de decisión. En primer lugar, se examinaron cinco variables potenciales para los 10 países que han obtenido medallas. Los resultados mostraron que el efecto "Anfitrión" no es un factor para ganar medallas, sino solo una norma de los eventos internacionales de tenis suave debido al sesgo de los datos causado por la extrema concentración de países anfitriones entre los cuatro primeros. Por otra parte, se constató que es necesario participar al menos 16 veces en eventos internacionales para ganar una medalla. Un resultado interesante para China Taipéi (CTP) fue que el tipo de superficie de la cancha, "dura" o no, era un factor que contribuía a ganar más medallas. En el segundo paso, se examinó la distribución de medallas de oro de los cuatro países que más medallas de oro han ganado. Los resultados mostraron que Corea del Sur

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(KOR) ha ganado más medallas de oro en canchas de arcilla, y CTP en canchas duras que el resto de canchas, respectivamente. Este estudio determina el efecto de la superficie de las canchas en la obtención de medallas a nivel nacional. También se descubrió que KOR ha ganado más medallas de oro en los Campeonatos Mundiales y en los Juegos Asiáticos que en otros eventos internacionales. Japón, por su parte, ha ganado más medallas de oro en los Campeonatos Asiáticos.

Palabras clave: *tenis suave, evento internacional, obtención de medallas, árbol de decisión.*

INTRODUCTION

Soft tennis originated in Japan after the introduction of lawn tennis in the nation. It is a modified version of lawn tennis that developed under the influence of Japanese culture. A few of the characteristic features of soft tennis are as follows: The rackets used are lighter than those used in lawn tennis, the balls are made with a soft membrane of natural rubber, and the doubles game is more popular than the singles game (Ida et al., 2005).

The first international soft tennis event was conducted in 1956 only among Korea (KOR), Chinese Taipei (CTP), and Japan (JPN), even though the game had been played for more than 50 years in KOR, CTP, and JPN by that time (Omote & Japan Soft Tennis Association [JSTA], 1985; 1986). The Japanese introduced soft tennis to the Korean Peninsula in approximately 1905 and to CTP in approximately 1907 (Omote & JSTA).

The first official international soft tennis event, the First Asian Soft Tennis Championship, was held in 1988, with the establishment of the Asian Soft Tennis Federation on February 6, 1988 (JSTA web site, a). After that, international events for soft tennis have been held regularly. There are four major international soft tennis events: the World Championships, Asian Games, East Asian Games, and Asian Championships. To date, 29 international soft tennis events have been held, with a total of 576 medals awarded to the players during these events.

Each soft tennis match consists of a sequence of seven or nine games; hence, the matches are generally played in a shorter amount of time than in tennis. Therefore, most players and coaches believe that the likelihood of uncertainty in the result of a match is very high. Despite a good understanding of the game, no studies have been conducted on factors that determine winning games in international soft tennis events; these events have a greater level of uncertainty regarding match results than do domestic events.

Most sports organizations announce their international rankings periodically on the basis of their original rating systems. For example, the International Tennis Federation, Association of Tennis Professionals, and Women's Tennis Association release the categorized rankings precisely, based on sex, age, and event. The rankings are calculated on an individual and national basis; however, these rankings only reflect the results. Therefore, players, coaches, and analysts need more useful information to help them win against their opponents.

Bernard and Busse (2004) clarified that the "host" is a better predictor than either the gross domestic product (GDP) or population for winning medals in the Olympic Games. The findings of many other studies were consistent with those of Bernard and Busse and reveal that the host is a strong predictor (Celik & Gius, 2014; Forrest et al., 2010; Hoffmann et al., 2004; Scelles et al., 2020; Vagenas & Vlachokyriakou, 2012), and a "home" advantage exists in the Summer (Balmer et al. 2003; Pettigrewa & Reicheb, 2016) and Winter (Balmer et al. 2001) Olympic Games.

In the context of players' performance, home seems to be equivalent to host for encouraging players. Nevill et al. (1997) examined the home advantage effect at the Grand Slam tournaments held in 1993 and reported that players had an effective home advantage only at Wimbledon. However, using four regression models Holder and Nevill (1997), reported little evidence of a home advantage at Grand Slam tournaments. Koning (2011) used a modified logistic regression model in his study, which revealed that a home advantage exists among male professional tennis players, but not among females. To date, it is not clear whether or not there is a home advantage effect at Grand Slam tennis tournaments.

The type of court surface affects the game patterns (Hughes & Clark, 1995; O'Donoghue & Liddle, 1998) and strategies (Hughes & Franks, 2004) in Grand Slam tennis tournaments. A study by McHalea and Morton (2011) revealed a surface effect among the top-ranking players in the Association of Tennis Professionals tour. However, a study by Corral (2009) did not reveal any conclusive surface effects in Grand Slam tennis tournaments, except in female player competitions on grass courts. As for soft tennis, because the ball differs from that used in tennis, the effects of the court surface for soft tennis players will differ from tennis.

The study by Koning (2011) used data from 2000–2008 for men and from 2007–2008 for women, as far as we know, which is the longest duration of data capturing for any study on racket sports science,

and examined the factors that may contribute to winning. Studies using data captured over long time periods can identify significant factors for winning, considering the rapid development of rackets, strings, and other equipment. Knowledge of factors that can help players win tournaments or international events can change the attitude of coaches toward the players and help evolve coaching methods for training them. However, only a few studies have been conducted investigating the number of medals awarded in racket sports in international events.

Fortunately, there is ample information on medals that have been awarded for international events in soft tennis. We summarized the results of four international events for soft tennis held between 1988 and 2019, citing the results described in the study by Omote and JSTA (1985) and on the website "Soft Tennis Homepage," administrated by the second author (Tanaka, 2019). These data include the results of both individual and team competitions. Table 1 shows information about the international soft tennis events held and the court surfaces used that were analyzed in this study. However, no analysis has been performed on these wins yet. But in analyzing the information, several problems can be assumed. Tables 1, 2, and 3 show the information on events, court surface, the results of medal winning, and the times of host experienced. It seems clear that the data is biased, especially in medal distributions and the number of host experiences. However, while the number of medals won is a result of the competitions, the number of host experiences is considered factors for the number of medals won. This means we must keep these in mind and care must be taken in the analysis. Thus, we will conduct two-stage analysis to explore the factors that contribute to the awarding of medals.

Therefore, the purpose of this study was to identify the factors that play a role in winning international events in soft tennis. The analysis was performed carefully, as we analyzed potentially biased data.

Table 1
Information about the international soft tennis events held and court surfaces used between 1988 and 2019.

	Events				Court surfaces		
	World Championships	Asian Games	East Asian Games	Asian Championships	Hard	Clay	Synthetic grass
Number of times	8	8	5	8	17	8	4

Table 2
Summary of the results of medal winning races in international soft tennis events.

Country	Gold	Silver	Bronze	Medal tally	Medal winning rate (%)
South Korea (KOR)	75	59	69	203	35.2
Japan (JPN)	54	49	66	169	29.3
Chinese Taipei (CTP)	23	31	64	118	20.5
China (CHN)	3	9	36	48	8.1
Indonesia (INA)	0	4	10	14	2.4
Philippines (PHL)	0	1	12	13	2.3
Thailand (THA)	0	1	5	6	1.0
North Korea (PRK)	0	1	1	2	0.3
Kazakhstan (KAZ)	0	1	0	1	0.2
Mongolia (MNG)	0	0	2	2	0.3

Table 3
Information about host experienced times for the countries and regions.

Events \ Countries	KOR	CTP	JPN	CHN	THA	INA	Other countries or regions	
World Championships	3	1	2	1	0	0	1	
Asian Games	2	0	1	2	1	1	1	
East Asian Games	1	0	1	2			1	
Asian Championships	1	1	3	0	2	1	0	
total	7	2	7	5	3	2	3	29

METHODS 1

Despite a history of medal races at international soft tennis events, there has been no investigation into them. Due to the low number of studies on soft tennis, we have little information about the factors that play a role in winning medals at international events. The data that we have include information on events, court surfaces, number of medals awarded to players, number of times a country hosted an event (Tables 1, 2, and 3), and number of international events attended (NIEA). Hence, it is inadequate to assume the factors that play a role in winning medals. Therefore, we need to employ an exploratory approach toward analyzing data, by outlining it first.

We propose that decision tree induction should be employed to obtain insights into soft tennis. A data mining technique can extract useful and previously unknown information from archived data (Ofoghi et al., 2013). Decision trees can also be used on datasets with missing values (Loh, 2008; Morgan et al., 2013). It is a non-linear technique and independent of selection of a prior data distribution (Kawabata, 2008). In addition, the results of decision tree induction can be expressed as a dendrogram, which could help coaches and analysts to interpret the relationships among variables. Further, this technique has the advantages of greater interpretability (Hastie et al., 2009) and the ability to provide greater insights into factors influencing results than linear methods (Written & Frank, 2005). Decision trees have also been used for sports studies such as curling (Willoughby & Kostuk, 2005), participation in daily physical activity, sports of children with disabilities (Ross et al., 2021), food prediction during endurance sport competitions (Fister et al., 2014), match quarter outcome in elite women's Australian rules football (Cust, 2019), and attacker–defender interactions in hockey (Morgan, 2013).

We applied decision tree induction for data analysis of the unbalanced provision of medals in soft tennis. The analysis was done carefully to avoid overfitting. We applied 10 times 10-fold cross-validation (Written & Frank, 2005). This procedure is reliable enough to produce an error estimate for most datasets. Further, we are trying to reconsider the "host" effect, as we do not have enough insight into the host effect yet. Therefore, we must compare the results with and without the host effect. Here we will define the host effect as equivalent to home advantage, because host and home are considered similar in the sense that they encourage to the player (see Figure 1).

All raw medal distribution data were collated and analyzed using JMP 14.3 (SAS Institute Inc., North Carolina, USA). The aim of using the decision tree here was to comprehend the features of the data and identify the possible candidates of variables for subsequent analyses.

Variables

Considering the features of soft tennis and its international events, we investigated five potential factors, described below:

1. **Court surface:** The coefficient of friction between the ball and the court surface varies depending on the material that the ball is made of (Cross, 2002b; Inaba et al., 2017). In addition, balls deform upon collision with a surface, increasing the area of collision (Cross, 2002a). In the case of soft tennis, rubber hollow balls easily deform upon collision, implying that there are more significant surface effects than there are in tennis.

2. **Event:** Although soft tennis has four major international events, the values and motivations of players depend on the scale of the event. One major motivational factor is the monetary reward for winning the World Championships or Asian Games in CTP (Chinese Taipei National Sports Medal and Scholarship Award, 2015), CHN (Tan & Houlihan, 2012), and KOR (Takahashi & Kiku, 2013). Further, players are virtually exempted from military service in KOR (Takahashi & Kiku). Therefore, these differences among the events influence players' motivations and performance.

3. **Country:** Soft tennis has been played for a longer period of time in KOR, CTP, and JPN than in other countries. Hence, it is natural for players from these countries to have a greater advantage in winning medals.

4. **Host:** Soft tennis is not an Olympic event. Although the Asian Games and the East Asian Games are not major competitions like the Olympics are, they are multi-sport events, and athletes must be registered with and sent by their respective national Olympic committees. The number of medals won by athletes is officially added to their national tally. Therefore, the trends followed at these events are similar to those followed at the Olympic Games. A home advantage is known to exist in individual sports, such as alpine skiing (Martin Gschwend & Alex Krumer, 2021), speed skating (Koning, 2005), boxing (Balmer, Nevill & Lane, 2005), and tennis (Koning, 2011). We believe that the host effect will also exist in soft tennis.

5. **Number of international events attended (NIEA):** Bernard and Busse (2004) also clarified that the effect of the medal share rate from previous Olympic events is a more efficient predictor than GDP and population. Medal share is expressed as a percentage of the population or GDP, since medal share relative to GDP or population is common in medal acquisition studies on the Olympics. Hence, Bernard and Busse argued that Olympic athletes are similar to durable capital goods that can give several good performances over a long period of time. Their argument indicates that athletes who attend a greater number of Olympic events have more experience; this is applicable to athletes of most sports. It is important for players to build their career with continued participation and by winning performances at international events. This is also applicable to sports organizations.
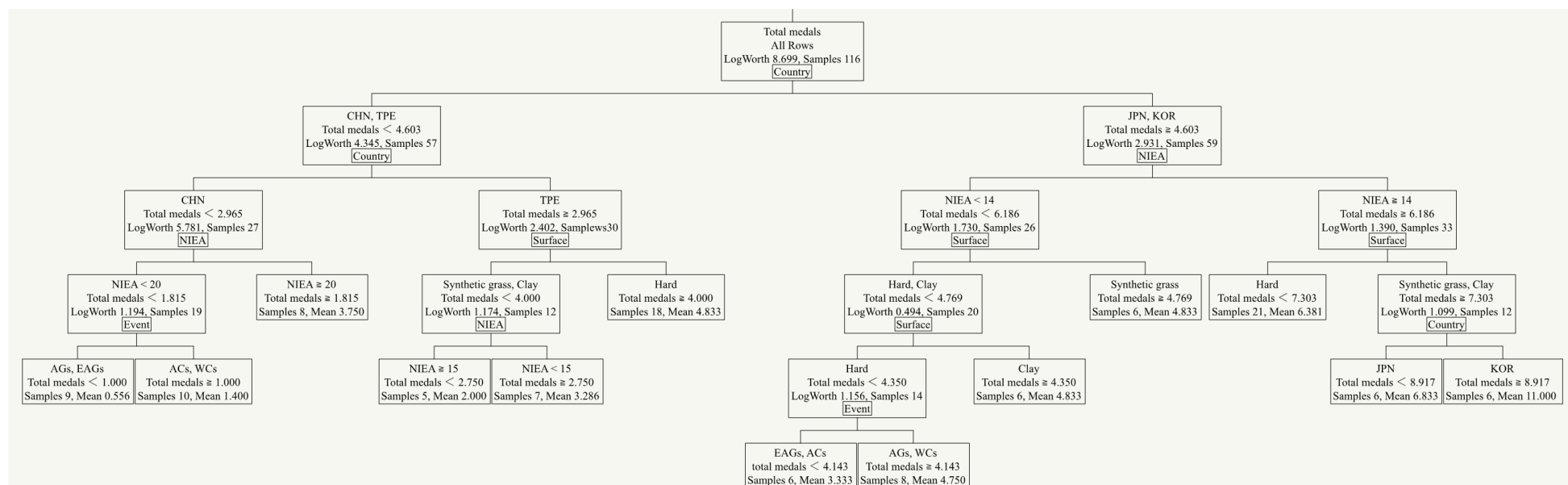
Figure 1. An example of the decision tree nodes for total medals among the top four countries.

RESULTS AND DISCUSSION 1

Our first goal in the exploratory analysis is to determine whether host effects exist. The first split in our decision tree model was caused by the attribute "Country" and the "Host" for total medals won and gold medals won were observed only for KOR, JPN and CTP, and only for KOR and JPN, respectively.

Table 4 shows the results of 10 times 10-fold cross-validation analyses for (i) 10 countries and (ii) the top four countries (KOR, JPN, CTP, and China (CHN)). Table 5 presents the results of the confusion matrices showing the relationships between the host effect and total medals obtained, and the accuracy of our model and recall on host effect. Considering the host effect, the root mean square error and coefficient of determination (R^2) values were close with or without the host in our model (Table 4). Confusion matrices indicated high accuracy to distinguish; however, recall values for both the ten countries and top four countries were very low (Table 5). Considering these results, the host was not deemed to be a factor for winning medals, but is a norm for international soft tennis events due to the data bias caused by exclusive host concentration (that is, the phenomenon that only certain countries are hosts. Table 3). Therefore, "Host" is excluded here for the subsequent analysis.

Table 4
Mean (± standard deviation) of root mean square error (RMSE) and coefficient of determination (R^2) on the results of 10 times 10-fold cross-validation analyses by decision tree inductions for the ten and top four countries.

| | ten countries | | | | top four countries | | | |
| | with host | | without host | | with host | | without host | |
RMSE	R^2	RMSE	R^2	RMSE	R^2	RMSE	R^2
1.407 ± 0.0187	0.798 ± 0.005	1.487 ± 0.0391	0.774 ± 0.0120	1.809 ± 0.0149	0.657 ± 0.006	1.951 ± 0.0562	0.601 ± 0.0233

Table 5
Confusion matrices showing the relationships between "Host" effect and total medals obtained, and accuracy of our model and recall on host effect.

| | | ten countries | | top four countries | |
| | | predicted | | predicted | |
confusion matrix	actual	yes	no	actual	yes	no
	yes	6	20	yes	6	15
	no	3	200	no	3	92
accuracy		0.900		0.845	
recall		0.231		0.286	

The results of our decision tree model showed two interesting outcomes for winning medals. For CTP, the court surface type, namely whether the court surface is "Hard" or not, was the contributing factor for winning more medals. In terms of winning medals, NIEA was a significant predictor for every country that attended international events more than 16 times. The attribute "Event" here did not indicate any effects.

This phenomenon implies the need to give systematic support to other countries via the International Soft Tennis Federation, which could yield more participants.

As a whole, all the attributes analyzed, except for "Event" and "Host", seemed to be good predictors. However, "Event" was a significant predictor for KOR and JPN, who collectively occupy 64.5% of the medal tally. "Event" is likely to be the key for success at international events in soft tennis. Therefore, the exclusion of "Event" is inadequate here. Hence, the remaining three attributes (Court surface, Country, and NIEA) also have been applied to the subsequent analysis.

METHODS 2

As collectively KOR, JPN, CTP, and CHN have won 93.2% of the awarded medals, analyzing the top four countries would make the de facto medal race analysis simpler. The aims of this section were to clarify the factors for winning medals in international soft tennis events more clearly and also to determine the factors that play a role in winning gold medals by analyzing the data of the top four countries that have won gold medals.

Considering the information provided in the RESULTS and DISCUSSION1 section, we proceeded more carefully with the analysis to avoid overfitting. In METHODS 2, we applied 10 times 10-fold cross-validation (Written & Frank, 2005) again.

RESULTS AND DISCUSSION 2

Figures 1 and 2 show examples of our decision tree model for total medals and total gold medals, respectively, among the top four countries. The first split in the model occurred when the attribute "Country" for KOR and JPN was equal to or greater than 4.603 for total medals. Considering the left side of the tree, as well as the RESULTS and DISCUSSION1 section, it is clear that CTP is winning more medals on hard courts, and during the 29 international competitions China has recorded better results in the last decade than in the last three decades. At the right side of the tree, the NIEA seems to be a good predictor for winning medals, but this was the result of an increased number of individual games played in international soft tennis events. Until 1991, only team and doubles events were played. Singles and mixed doubles were first played in 1992 and 2002, respectively. As those results, the number of total medals increased for KOR and JPN.

Considering the left side of the tree in Figure 2, CTP has an advantage for winning gold medals on hard courts. Based on the right side of the tree, KOR has won more gold medals in the Asian Games and World Championships than in the Asian Championships and East Asian Games. This is possibly owing to the social structure in KOR. Players are given monetary rewards and virtually exempted from military service in KOR upon winning gold medals at the Asian Games and World Championships (Takahashi & Kiku, 2013).
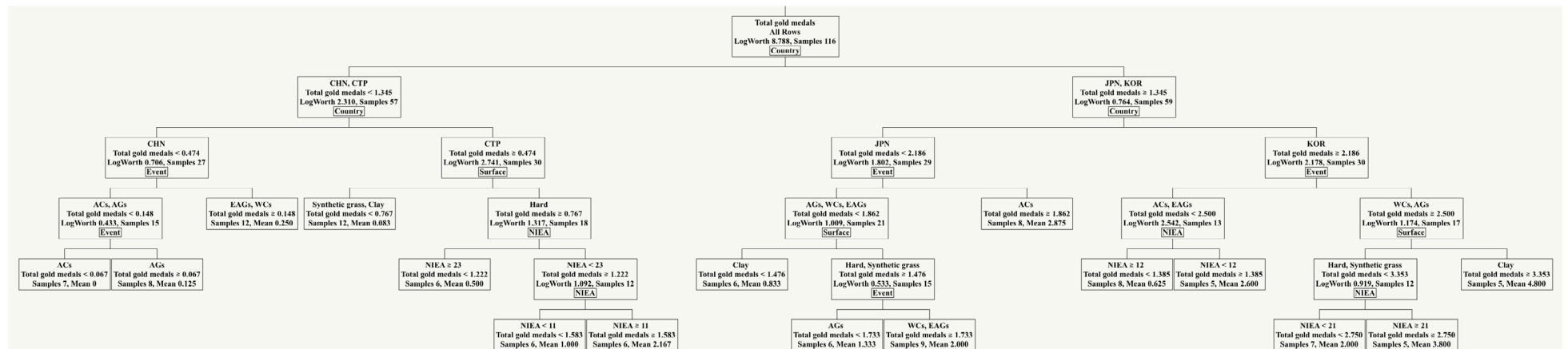
Figure 2. An example of the decision tree nodes for total gold medals among the top four countries.

Further, CTP has an advantage on hard courts, whereas KOR has an advantage on clay courts. On the other hand, JPN has won more gold medals at the Asian Championships than at other events.

GENERAL DISCUSSION

We analyzed the results of the medal winning games of 29 international events in soft tennis held from 1988 to 2019 by using decision tree induction. At first, we analyzed the results of ten countries that had won medals at international events.

The results of the analysis revealed that the chances of winning medals are greater when a country participates in a minimum of 16 international events. For players in other countries, it is difficult to beat players from the top four countries due to the lack of equipment and the difficulties associated with it to hold domestic tournaments (Philippine Soft Tennis Association, personal communication on a certificate of gratitude to Seiji Kusubori on the donation of used rackets. June 5, 2005). Consequently, it will be difficult to gain playing experience in those countries. Even for Chinese players, participation experience in more than 20 events is needed to win gold medals. The argument by Bernard and Busse (2004) on Olympic athletes suggests that players who participate in the Olympic Games several times have more chances to grow in experience, and this is also applicable to other sports organizations. Hence, it is essential for all nations to attend international events continuously each year.

Especially for Southeast Asian countries, it is essential to achieve good results in the Southeast Asian Games to be permitted to attend the Asian Games; the National Olympic Committee can exclude poorly performing nations from participating in the Asian Games (A. L. Tamayo [The president of Philippine Soft Tennis Association] & J. Mamawal [The head coach of Philippine Soft Tennis Team], personal communication, November 13, 2010). Therefore, the International Soft Tennis Federation should support Southeast Asian countries in training and shaping the careers of their players, coaches, and organizations by allowing continuous participation at international events. This may help to reduce the concentration of host country in the top four. The concentration of host country results in unbalanced medal distribution and appears to discourage other national athletes from competing against national athletes from the top four countries.

Another major problem is that the World Championships are held only once every four years. This situation makes it difficult for even highly skilled tennis players to adjust to the differences in equipment, especially the ball (C. Craig [former U.S. national team player and professional tennis coach], personal communication, April 1, 2005). In the European region, several open tournaments have been held as international tournaments (JSTA website,

b). However, these tournaments are only events, and the participating players are always only those from the host country and Asian stars invited for demonstrations. Without systematic and sustained promotion of the sport in regions outside of Asia and support for the participation of players from such regions in international tournaments, it will be difficult to raise the sport's profile as a meaningful international sport. Despite the long history of soft tennis, it seems clear that there has been little progress in promoting and supporting the sport outside of Asia. The reason for this may be that soft tennis is recognized as a mass sport and its diffusion as an international competitive sport has been delayed, as evidenced by the fact that the first international soft tennis tournament in 1956 was held in only three countries: KOR, CTP and JPN (Omote & JSTA, 1985).

Currently, a World Championship is held only once every four years, but since the East Asian Games ended with the 6th East Asian Games in 2013, soft tennis is now in an environment where a World Championship can be held at least once every two years. In addition, soft tennis has team (national) competition, doubles, singles, and mixed doubles, but it would not be necessary to hold all of these events at every World Championship. Although there is still room for various innovations in holding the World Championships, the current situation remains unchanged, which is another major problem.

Our study revealed an interesting finding based on court surfaces. CTP and KOR have an advantage in winning the most total gold medals on hard and clay courts, respectively. This reflects the geographical factors of CTP and the competition environment in KOR. As CTP players often play on hard courts (K. Koh [former CTP head coach], personal communication, March 31, 2005); therefore, CTP players are more familiar with hard courts. CTP also adopted original playing styles earlier than the other countries, and these are considered reasonable strategies (Shinohara, 2019). On the other hand, players in KOR usually play on clay courts, and the tennis courts built for the purpose of soft tennis are normally clay courts (H. S. Kim [The managing director of KOR Soft Tennis Association], personal communication, November 14, 2018). We summarized the results of the careers of all tennis players for each court surface using the data from the Ultimate Tennis Statistics (Table 6). Spanish and South American players seem to have more significant advantages playing on clay courts than on other court surfaces. Date (2018) mentioned that this may be due to a greater ratio of clay courts than other types of courts in such countries.

In tennis, the surface effect for individual players was examined (Hughes & Clark, 1995; Hughes & Franks, 2004; O'Donoghue & Liddle, 1998; McHalea & Morton, 2011). However, our findings in soft tennis differed for each country. The surfaces used by players during the early period of their career affected their professional

future (Reid et al., 2007; 2009). In addition, Date (2018) argued that the synthetic grass surface courts used widely in JPN prevent the success of their players. This indicates that the success of players depends considerably on their familiarity with the court surface. Fans and coaches often emphasize that South American and Spanish tennis players, especially Rafael Nadal, perform better on clay courts (Date, 2018). Both South America and Spain yield high performance players with powerful records on clay courts (Table 6). However, the records for South American and Spanish players do not have significant differences statistically. Our data show significant differences among the countries. This implies that court surface familiarity is more important for soft tennis than for tennis, as the tennis ball with a soft membrane of natural rubber is easily deformed on collision with the court surface.

Table 6

The numbers of South American and Spanish players who have within Top 50 and 100 lifetime records for three types of courts (clay, glass and hard). South American players are belonging to Argentina, Chile, Brazil, Ecuador and Paraguay.

Types of courts	South American players		Spanish players		South American and Spanish players	
	Top50	Top100	Top50	Top100	Top50	Top100
clay	8	15	8	15	16	30
glass	2	2*	3	5	5	7
hard	4	6	1	5	5	11

Note. No statistical differences existed among types of courts. *No players existed between 50 and 100.

KOR has won gold medals in the Asian Games and World Championships. KOR players have not only won medals at premier events, but are also highly motivated to win gold medals at these events. One of the reasons for these characteristics is that winning a gold medal at such events leads to virtual exemption from military service for KOR players, along with monetary rewards (Takahashi & Kiku, 2013).

Unfortunately, the outcomes for CTP and CHN were not similar to those for KOR. We believe this indicates a need for more detailed analyses on gold medal distributions. On the other hand, JPN has won gold medals in the Asian Championships. In other words, the biggest challenge that JPN faces is finding a strategy by which to win gold medals in the Asian Games and World Championships.

Our findings reflect results at the national level, but do not reflect the background of individual players. There have been cases where players who originally played tennis have competed in international soft tennis events and won medals. Further, our analytical model does not take into account the results of any international events other than the four major events. If the background of individual players and the relationships between the results of the four

major events and those of other international events could be clarified, the path to success at the World Championships and Asian Games could be clarified.

CONCLUSION

The medal distributions of 29 international events in soft tennis held between 1988 and 2019 were skewed toward four countries, KOR, CTP, CHN, and JPN. Due to this unbalanced distribution, a host advantage did not exist in international soft tennis events. Participation in more than 16 international soft tennis events appears to be highly linked to winning medals.

Court surface significantly affected the medal tally for KOR on clay courts and CTP on hard courts. In other words, KOR and CTP have advantages on clay and hard courts, respectively. This study determines the effect of court surfaces on winning medals at a national level; this has not yet been reported for other sports.

KOR has won more gold medals in the Asian Games and World Championships than any other country.

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CONFLICT OF INTERESTS

The authors have declared there is not any potential conflict of interests concerning this article.

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