The Association Between Drop Shot Subtype Frequency and Set Outcomes in the 2024 KAIAC Girls' Varsity Doubles Badminton

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ABSTRACT

Previously, elite badminton games were analyzed for technical variables. However, women's doubles matches and non-elite badminton games have received less scholarly attention. Therefore, this study aimed to determine whether the frequency and subtypes of forehand net drops, backhand net drops, forehand over-the-head drops, and backhand over-the-head drops were associated with set win-lose outcomes in girls' varsity doubles at the 2024 Korean-American Interscholastic Activities Conference (KAIAC) Badminton Championships. All girls' varsity doubles games (matches = 23 and sets = 49) at the 2024 KAIAC Badminton Championships were analyzed. The analysis demonstrated that there was no association between drop shot frequency of different subtypes and set win-lose outcomes in the population studied. The findings address the lack of shot-specific and non-elite research and suggest that coaches, players, and prospective sports data analysts remain open to contextual and technical variables rather than solely focusing on drop shot frequencies.

KEYWORDS

Badminton, Drop Shots, Statistical Data Analysis, Performative Analysis, Sports Performance

LITERATURE REVIEW

Throughout recent years, data analysis has made its way into sports; in fact, sports analysis in sports clubs is prevalent, enhancing the understanding of the flow of sports games (Sheinin, 2025). Though the high number of data departments might nullify the need for researchers to conduct sports data analysis, Schaerlaeckens counters the potential argument, arguing that researchers "have less time pressures" (Schaerlaeckens, 2025), emphasizing the necessity for scholars to advance the precision of analytics in sports. Careful, sport-specific analysis is needed to prevent overreliance on general models of play through specific analytical approaches within each sport.

Badminton, with limited research, yet characterized by high-intensity effort by consecutive movements within rallies, demands its own analysis (Abdullahi & Coetzee, 2017; Sheng et al., 2022). From personal observation in non-elite doubles competitive play, drop shots often appeared to be effective and result in winning sets, as opponents struggled to return them. It was also observed that participants of the Korean-American Interscholastic Activities Conference (KAIAC) championships, such as Korea International School and Seoul International School, employ drop shots throughout the rally and were among the first three ranked. This observation raises questions regarding the role of drop shots in non-elite badminton.

To outline, past research is limited categorically, with some comparing between singles matches or occasionally doubles. Previous studies provided basic coaching suggestions and a general analysis (Abián et al., 2014; Chiminazzo et al., 2018; Phomsoupha et al., 2014). While earlier studies did not focus on specific shots, more recent research utilizes tracking technologies and differentiates technical variables, which refer to shot types. Some researchers focus on “impulse shots” while others focus on the comparison of technical variables and categories (Pérez-Turpin et al., 2020; Hammes & Link, 2024; Hsu et al., 2024; Winata et al., 2025). This signals a shift that allows for differentiation between categories, collectively illustrating the necessity of conducting research in distinct match categories rather than generalizing findings as each category presents a unique characteristic of its own.

A major foundational study from Macquet and Fleurance asserts that a crucial factor that determines the outcome of a badminton match for elite athletes is shot decisions (Macquet & Fleurance, 2007). The main intentions of choosing a particular shot are “‘to maintain the rally’; ‘to take an advantage to build the rally’; and ‘to finish the point’” for elite badminton players, outlining that shot decisions are associated with rally flow and outcomes (Macquet & Fleurance, 2007). However, whether this theory extends to the non-elites is yet unknown, as Blomqvist et al. outline that “experts exhibited more sport skill and understood the game situations better” (Blomqvist et al., 2000). In particular, the drop shot, a shot that "imitates between the clear and smash shots which ends up the shuttle to fall on the front line of the opponent's court" (Bakar, 2017), is worthy of research. The drop shot is widely used, and previous scholars emphasize the player’s intent of choosing a drop shot in order to influence the rally to “play wide” or to “surprise opponents” (Macquet & Fleurance, 2007). This highlights that the drop shot is a strategic decision that benefits players and coaches, as it is associated with badminton match results.

To further refine badminton analysis, it is crucial to investigate individual subtypes of a shot, since individual subtypes can associate with set and point outcomes (Chiminazzo et al., 2018; Pérez-Turpin, 2020; Sheng et al., 2022). As aforementioned, the drop shot in badminton combines characteristics of both the clear and the smash, landing near the front of the opponent’s court softly (Bakar, 2017). To define the subtypes, an over-the-head drop shot, one subtype, is a "smooth shot from above the head with a downward trajectory towards the front of the court" (Phomsoupha et al., 2014; Abián et al., 2014). A net drop, another subtype, is similar, but it is rather a "precise shot from near the net" (Phomsoupha et al., 2014; Abián et al., 2014). Together, these variations highlight the significance of the drop shot as both an offensive and defensive tool.

POPULATION IN BADMINTON STUDIES

Previous badminton shot analyses are notational and focus on men’s singles matches, often utilizing Olympic footage, like Abián et al., rather than a variety of different matches (Abián et al., 2017). Demographically, shot frequency analyses have focused on men, such as the men’s singles from the Olympics (Cenan & Pamuk, 2022). Sheng et al.’s study complicates the population researched by researchers Cenan and Pamuk, as they compare shots between genders in singles (Cenan & Pamuk, 2022; Sheng et al., 2022). These analyses exemplify that the study population of previous literature has revolved around men and singles, indicating the biased population in current studies.

Furthermore, Cenan & Pamuk and Sheng et al.’s research collectively researched elites (Cenan & Pamuk, 2022; Sheng et al., 2022). Specifically, Seth chose to research elites who voluntarily chose to participate (Seth, 2016). Rather than voluntary participation, Cenan & Pamuk chose to analyze men’s singles games recorded during the 2020 Olympics, while Abian-Vicen et al. chose to broaden their scope by comparing men’s and women’s singles in the 2008 Olympics (Abian-Vicen et al., 2013; Cenan & Pamuk, 2022). However, these studies still lack analyses in the doubles category.

SHOT ANALYSIS IN BADMINTON STUDIES

Previous works have investigated shot frequency and its general relation to the game, while limited research has focused on specific shot types. Studies have mainly focused on shot analysis at the whole-match scale, uniformly incorporating the smash, clear, drop, net drop, and drive as their technical variable to investigate their general association (Abian-Vicen et al., 2013; Chiminazzo et al., 2018; Hammes & Link, 2024). This suggests that previous studies often overlook individual shot types, which may hinder the enhancement of knowledge. Additionally, researchers furthered the scope of variables, with Chiminazzo et al. also analyzing the serve and Abian-Vicen et al. investigating unforced errors as one of their dependent variables (Abian-Vicen et al., 2013; Chiminazzo et al., 2018).

However, specific drop shot sub-categories still remain underexplored. Although Pérez-Turpin et al. have utilized the subtypes of the service and clear as their variables (Pérez-Turpin et al., 2020), it is evident that subtypes of the drop shot require further research. Indeed, Chiminazzo et al. identified the smash as the most important in the whole match scale and admitted that "the effectiveness of [individual] shots was not" analyzed (Chiminazzo et al., 2018), underscoring the negligence on how specific shot types are associated with set results.

GAP

Previous studies suggest that current research leaves a gap regarding the study population. Also, previous studies leave an uncertainty about the patterns displayed in the winning and losing sets in the non-elite population. Furthermore, no research focuses on specific subtypes of drop shots and their association with point outcomes, providing an identifiable gap that this research intends to cover. Therefore, research on girls' doubles addresses this gap and will offer new insights into research, especially because "the frequency of shots is increased" in doubles, compared to singles and women's matches, "are characterized by more defensive play and smoother shots" (Winata et al., 2025).

A notable non-elite badminton play population that is worthy of research is the Korean-American Interscholastic Activities Conference (KAIAC), a non-profit unincorporated organization with 17 international high schools in South Korea (Korean-American Interscholastic Activities Conference, n.d.). The population is valuable in examining how shot choices associate with set results outside professional settings, albeit with a structured and competitive context. Studying this population addresses an important gap, offering insights into the underexplored category that is different from men's singles play and elite play.

Moreover, evaluating the sub-categories of the drop shot and evaluating their association with winning and losing sets in non-elite badminton addresses the call for shot-specific research. To respond to the current call for sport-specific research with specific subtypes and women's doubles in the non-elite population, this research poses the following question: To what extent are the frequency and subtypes of net drops and drops (forehand/backhand) in badminton associated with set win-lose outcomes in girls′ varsity doubles at the 2024 KAIAC Badminton Championships? It is hypothesized that sets with a higher frequency of drop shots, especially net drops, will have a positive association with set wins in girls' varsity doubles. This is due to prior findings, which state that net drops, in many cases, are the shots that end rallies (Abián et al., 2014; Abian-Vicen et al., 2013).

METHODS

This study aimed to collect data on the number of drop shots and the win and loss results of each set for non-elite badminton players. However, due to the vast number of non-elite games worldwide, the KAIAC championships held in 2024 were specifically analyzed in order to obtain a reasonable level of results. Accordingly, a retrospective approach was used, converting existing video footage into numerical data through observation and coding. The data collected was then analyzed for the association between frequency and winning. The set, which ends when either team earns 21 points, served as the unit of analysis.

In order to do so, 23 girls' doubles games with a total of 49 sets were analyzed. The matches were filmed by the Seoul Foreign School Athletics Department during the 2024 Badminton KAIAC games. These videos are publicly available on YouTube and include all rallies that are played throughout the championship, from courts 1 through 11. The data were collected noninvasively by analyzing all 6163 shots on the courts. One observer with six years of competitive badminton experience collected data in accordance with the defined variables that will be detailed in the following section. The method of this study partially follows the research method of Abian-Vicen et al., where one observer with experience also manually counted and classified shots (Abian-Vicen et al., 2013).

While research conducted by Abian-Vicen et al. classified the shots through written definitions, the present study classified shots through both written definitions and the trajectory of shots to precisely distinguish between subtypes (Abian-Vicen et al., 2013).

Each badminton shot has a different known trajectory, and the net drop and drop are known to have a trajectory that is particularly downward compared to other shots, as shown in Figure 1. These definitions of trajectories were used in the research of Bakar and Wang et al. (Bakar, 2017; Wang et al., 2023).

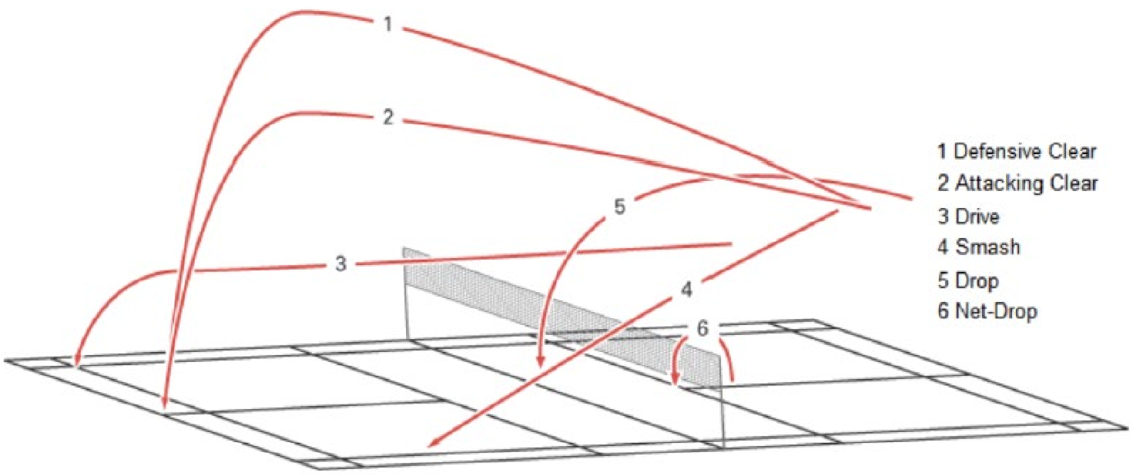

Figure 1. Trajectories of Badminton Shots (Bakar, 2017)

For this particular research, the trajectories of the drop and the net drop, numbers 5 and 6, respectively, are worth attention. In addition to the definitions of the drop shots based on trajectories, as shown in Figure 1, the technical independent variables are classified into net drops and over-the-head drops (drops). Each shot is grouped as a forehand or a backhand shot. The win-lose outcome of each set is considered binary, as shown in Figure 2. The subclassification of forehand and backhand strokes was used in the research of other scholars (Cenan & Pamuk, 2022; Seth, 2016).

Independent Variable	**Definition**
Total Shots Hit	The total number of shots hit in a rally
Forehand Net Drop	"Precise shot from near the net" (Phomsoupha et al., 2014; Abián et al., 2014)
Backhand Net Drop	

Forehand Over-the-head Drop	"Smooth shot from above the head with a downward trajectory towards the front of the court" (Phomsoupha et al., 2014; Abián et al., 2014)
Backhand Over-the-head Drop	
Dependent Variable	**Definition**
Win/Lose Results	Binary: Either Win or Lose (Sitti & Rangubhet, 2025)

Figure 2. Independent and Dependent Variables (Classification of Drop Shots and Win/Lose)

To eliminate observer fatigue, the observer watched pre-existing footage at 0.75 speed. Then, the technical variables were put into Google Sheets, as shown in Figure 3. During each set, the total number of shots played was recorded, including non-drop shots. Although the research objective is to analyze drop shots, the total number of shots played is necessary in order to determine the frequency and proportion of drop shots within the overall gameplay. Research done by Hammes & Link also counted all shots in order to obtain the frequency (Hammes & Link, 2024). Furthermore, the classification was checked by two coaches with more than five years of experience if the observer was unable to determine the shot, either due to the definition or the path. The coaches provided unanimous classifications, enhancing coding accuracy. The cross-checking process helped reduce major classification errors and enhanced the overall validity of the data despite the absence of formal statistical reliability measures.

To detail specific steps, when a drop shot is executed by a player during analysis, the observer identified the drop shot according to the subtype as identified in Figures 1 and 2 and increased the tally by one in the correct cell of the table (Figure 3). For example, if Team 1 executed a Forehand Net Drop, the observer incremented Team 1's "Number of Forehand Net Drop" cell by 1.

After every set, the observer identified the win-lose outcomes for each team. Although manually recording the total number of drop shots might be invaluable data in order to determine frequency, it is unnecessary for initial analysis because the total number of separate drop shots can be added up in order to obtain the total number of drop shots. All results were placed into the sheet, as seen in Figure 3, then tallied up to determine the frequency of drop shots, set win-lose, and the total number of drop shots.

	Team 1 (Manual)	Team 2 (Manual)	Total (Automatic)
Total Shots Hit			
Number of Forehand Net drops			
Number of Backhand Net drops			
Number of Forehand Over-the-Head Drops			
Number of Backhand Over-the-Head Drops			
Win/Lose (1/0)			

Figure 3. Data collection for each set

$$\text{Drop Shot Frequency} = \frac{\text{Number of Drop Shot Subtype}}{\text{Total Shots in Set}}$$

The frequency out of drop shots was calculated with the formula

$$\text{Drop Shot Frequency} = \frac{\text{Number of Drop Shot Subtype}}{\text{Total Drop Shots in Set}}$$

The calculation allows the researcher to quantify the frequency while reducing bias for different numbers of total shots. By measuring both the overall proportion of drop shots and the relative distribution, the analysis can determine whether certain drop shot strategies are associated with set win-lose outcomes.

Then, descriptive statistics, the mean, median, standard deviation, and the first and third quartiles, were calculated at the set level. Given skewed distributions as shown in the candlestick models, both parametric and non-parametric measures were calculated to ensure that conclusions were not influenced by outliers. The standard deviation and interquartile range (IQR) were calculated to assess variability between winning teams and losing teams in sets.

A simple logistic regression model was conducted separately for each drop shot subtype, with the set outcome (win or lose) as the nominal outcome and shot frequency as the measurement variable. Separate models were used for each frequency to keep the analysis appropriate for the sample size. Multiple logistic regression was not conducted because the sample size was small and the model may become overfit. A simple logistic regression is meaningful because it allows the researcher to examine whether the frequency of each drop shot subtype predicts the probability of winning. The p-value was considered significant when less than or equal to 0.05.

RESULTS

A total of 6163 shots played by the Varsity Girls' Doubles players in the 2024 KAIAC were classified, if applicable, as a forehand net drop, a backhand net drop, a forehand over-the-head drop, or a backhand over-the-head drop (Appendix 1). The distributions were calculated on a set level. The data include 49 sets, where each set has a winning team and a losing team. Winning and losing sets were evenly distributed, where 50% were winning sets and 50% were losing sets. Slightly more than a tenth of all shots that were analyzed were drop shots. Overall, drop shots were more than a tenth (11.79%) of the total shots analyzed per match. The forehand over-the-head drop (7.47%) constituted the majority of the drop shots (Figure 4).

	Overall Mean	Overall SD
% of Total Net Drops and Drop Shots Out of Total Shots	11.79	6.86
% of Total Forehand Net Drop Shots Out of Total Shots	1.61	1.95
% of Total Backhand Net Drop Shots Out of Total Shots	1.36	2.06
% of Total Forehand Over-the-Head Drop Shots Out of Total Shots	7.47	5.36
% of Total Backhand Over-the-Head Drop Shots Out of Total Shots	0.92	1.37

Figure 4. Comparison of Overall Shot Frequencies Out of Total Shots in the 2024 KAIAC Tournament

Figure 5 shows the mean frequency distribution of the frequency of drop shot types within total drop shots. The figure demonstrates that losing teams in sets (20.08%) have a higher frequency of forehand net drops than winning teams in sets (14.01%). Furthermore, winning teams in sets (65.12%) have a higher frequency of forehand over-the-head drop shots than losing teams in sets (57.41%).

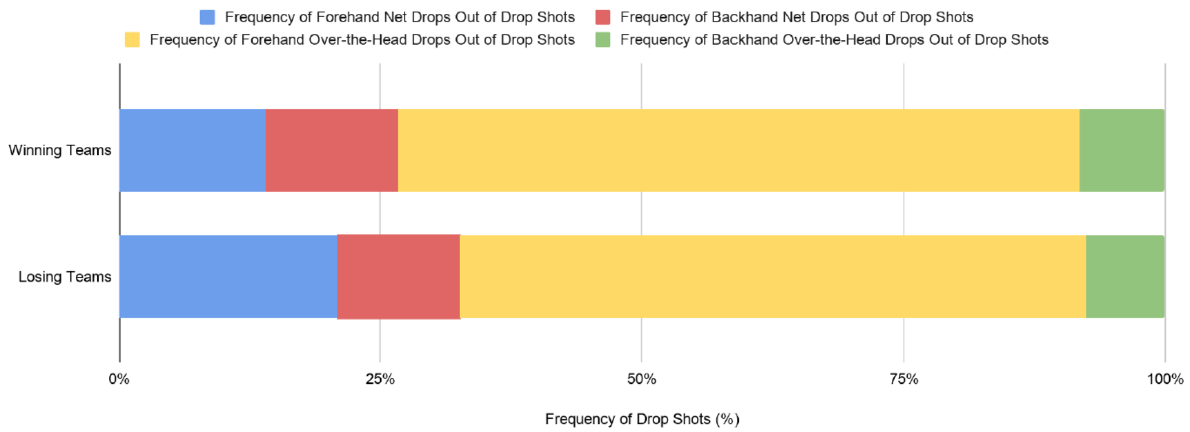

Figure 5. Relative Mean Frequencies of Drop Shot Types Within Total Drop Shots in the 2024 KAIAC Tournament

Mean shot frequencies were calculated separately for winning and losing sets. No substantial differences in the mean value were found between win and lose sets (Figure 6).

The losing sets exhibited greater variability for forehand net drops (SD = 2.12), forehand over-the-head drop shots (SD = 6.13), and backhand over-the-head drop shots (SD = 1.58). The variability was marginally greater for winning sets for backhand net drops (SD = 1.91).

Overall, the standard deviations of the total net drops shots and drop shots frequencies for winning and losing sets were 5.68 and 7.92, respectively, suggesting that while the average shot frequencies were similar across the entire tournament, there was a greater variability in the frequency of drop shots among losing sets.

	Win Set Mean	Win Set SD	Lose Set Mean	Lose Set SD
% Total Net Drops and Drop Shots	11.71	5.68	11.87	7.92
% Total Forehand Net Drop Shots	1.30	1.73	1.92	2.12
% Total Backhand Net Drop Shots	1.48	2.21	1.23	1.91
% Total Forehand Over-the-Head Drop Shots	7.45	4.51	7.49	6.13
% Total Backhand Over-the-Head Drop Shots	0.92	1.13	0.94	1.58

Figure 6. Comparison of Overall Shot Frequencies by Game Outcome in the 2024 KAIAC Tournament

The percentages among losing sets show greater dispersion than those among winning sets. Furthermore, the interquartile range (IQR) is wider for the losing sets (Q1 = 5.77, Median = 9.80, Q3 = 17.54) than that of the winning sets (Q1 = 7.41, Median = 11.29, Q3 = 15.28). The narrower IQR indicates a more compact middle 50% of values, suggesting a more consistent shot distribution among the winning sets (Figure 7). This pattern corresponds with previous descriptive findings, such as the standard deviation.

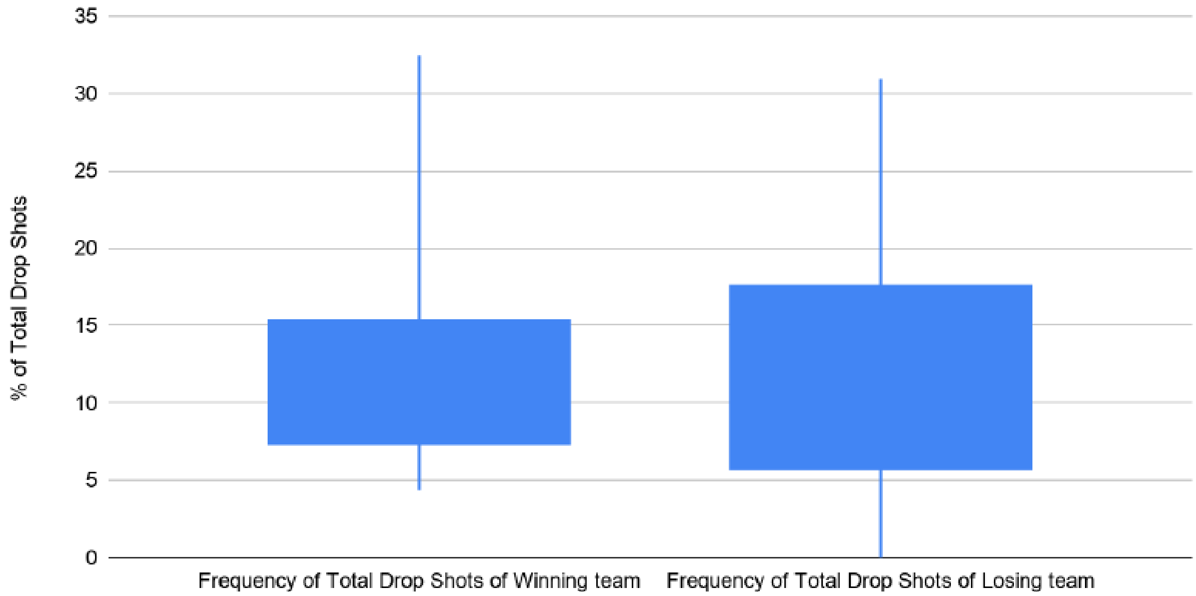

Figure 7. Distribution of Total Drop Shot Frequencies by Set Outcome through Box Chart in the 2024 KAIAC Tournament

The percentage of forehand over-the-head drop shots among both winning and losing sets was slightly shifted to lower forehand over-the-head drop shot percentage values.

A major difference is that the interquartile range (IQR) is narrower for winning sets (Q1 = 4.26, Median = 6.12, Q3 = 8.76) than that of losing sets (Q1 = 3.15, Median = 5.81, Q3=10.35) for over-the-head drop shots (Figure 8). Additionally, the IQR for the percentage of backhand net drop is more clustered for winning sets (Q1 = 0, Median = 0.99, Q3 = 2.29) than for losing sets (Q1 = 0, Median = 0, Q3 = 3.07), similar to forehand over-the-head drop shots (Figure 9). The mode of the dataset was 0 for losing sets of backhand net drops.

This IQR pattern for winning and losing sets is consistent with total drop shot frequencies and with previous descriptive results. However, the maximum frequency is greater for winning sets than for losing sets. This indicates that although most backhand net drop frequencies in winning sets are tightly clustered, winning sets occasionally have a high backhand net drop shot frequency.

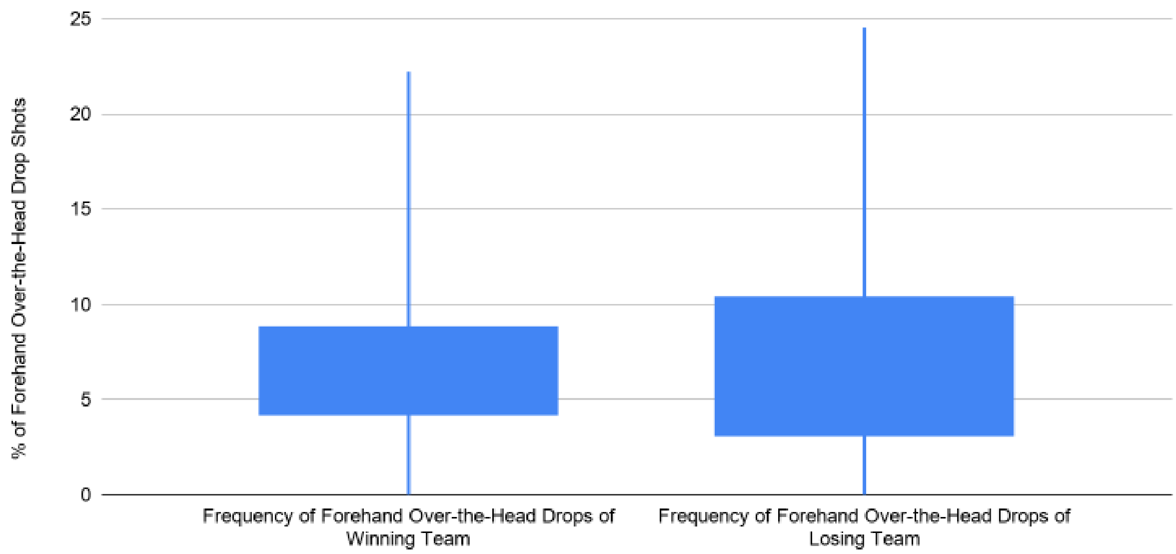

Figure 8. Distribution of Forehand Over-the-Head Drop Shot Frequencies Out of Total Shots by Set Outcome through Box Charts in the 2024 KAIAC Tournament

The distribution of backhand over-the-head drop shots demonstrates similar IQRs for both winning (Q1 = 0, Median = 0, Q3 = 1.55) and losing teams (Q1 = 0, Median = 0.93, Q3 = 1.67) in sets, as demonstrated in Figure 10. However, the median is greater for losing teams than for winning teams, indicating a tendency for backhand over-the-head drop shots to be marginally used more frequently in losing teams in sets.

Similarly, forehand net drop shots were used less in winning teams in sets and more in losing teams in sets, with an IQR of 0.02 for winning teams and 3.15 for losing teams, respectively, despite a higher maximum value for winning teams (Figure 11).

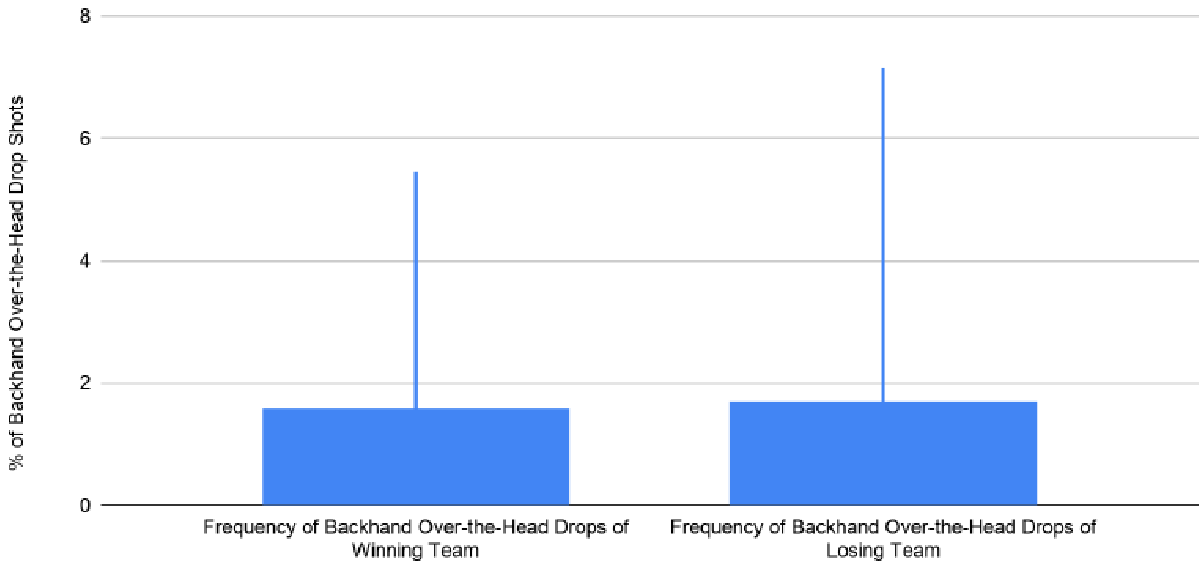

Figure 10. Distribution of Backhand Over-the-Head Drop Shot Frequencies Out of Total Shots by Set Outcome through Box Charts in the 2024 KAIAC Tournament

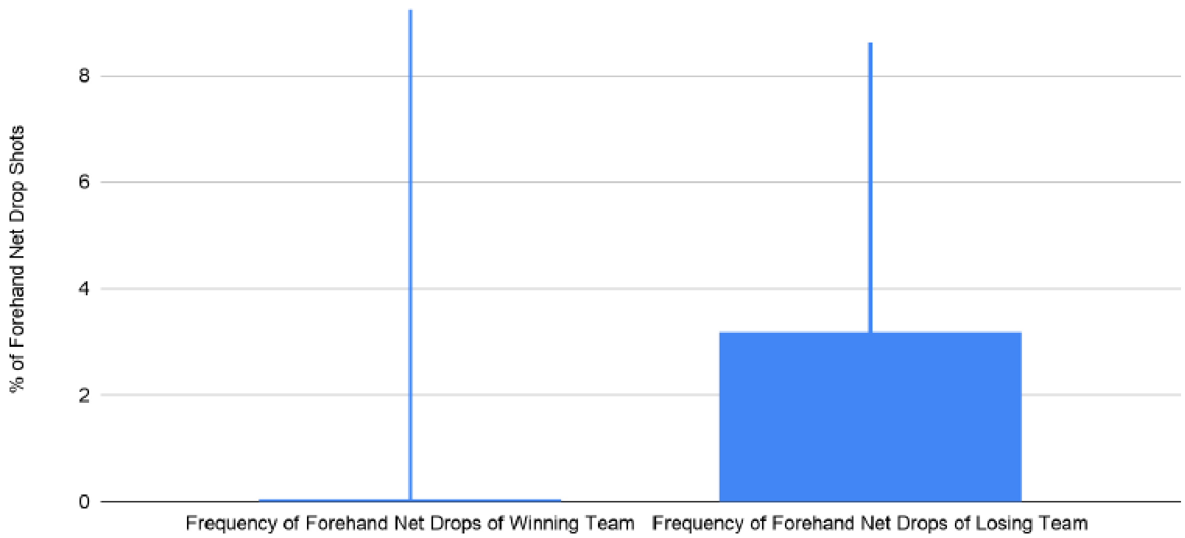

Figure 11. Distribution of Forehand Net Drop Shot Frequencies Out of Total Shots by Set Outcome through Box Charts in the 2024 KAIAC Tournament

In all, these results suggest that variability in drop shot subtype and frequency differs across outcomes. Specifically, winning sets demonstrate narrower IQR across different subtypes, indicating tighter clustering relative to that among losing sets. This applies to various descriptive measures, including standard deviation and IQRs, leading to possible statistical significance.

A simple logistic regression was used to examine whether the frequency of drop shots is related to the set outcome (win = 1, lose = 0). Separate regression models were used for total drop shots, and each subtype out of the total shots played and out of total drop shots played.

The logistic regression model for total drop shot frequency demonstrates no statistically significant results with a linear logistic graph (Figure 12).

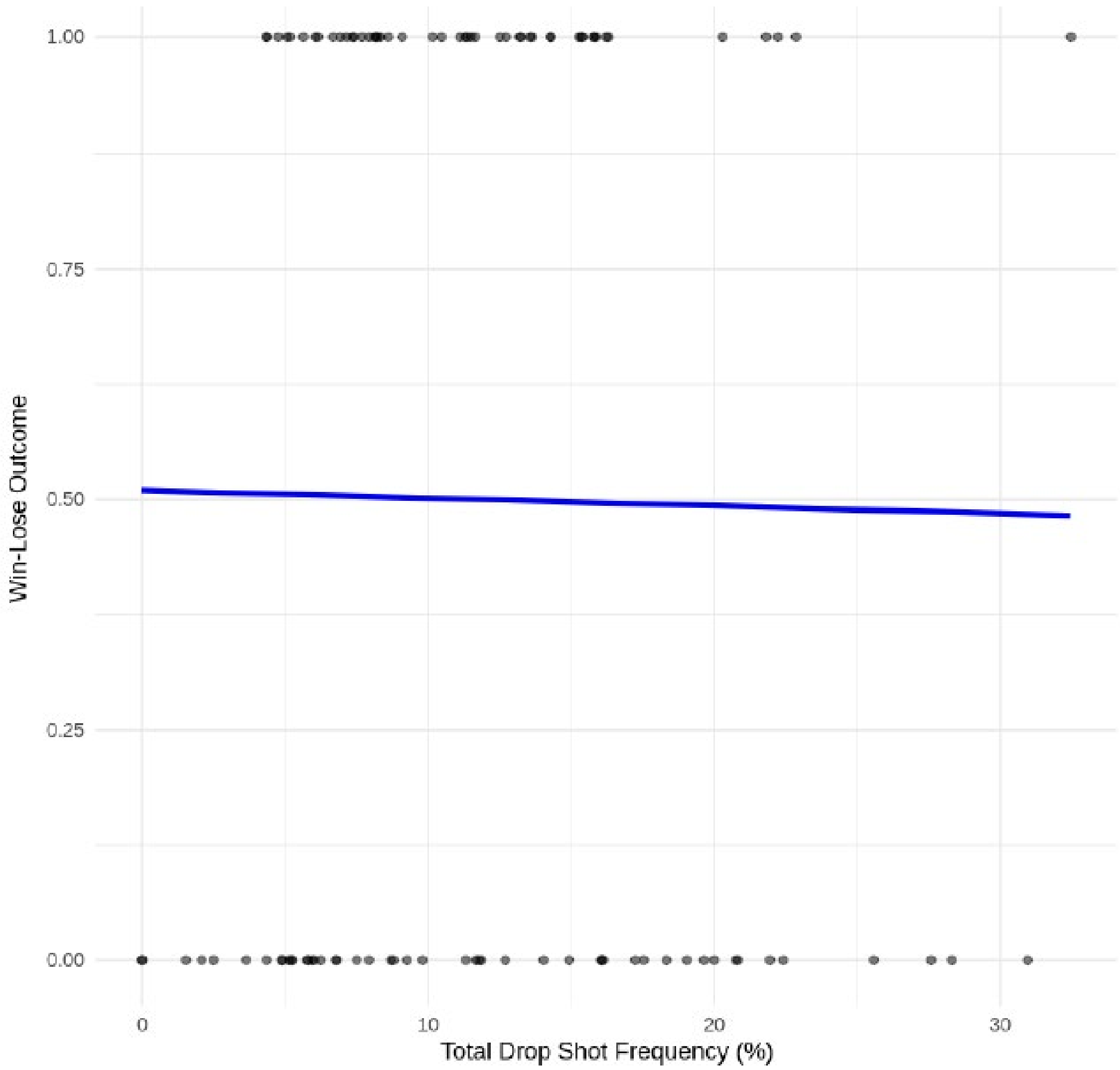

Figure 12. Logistic Regression Model for Total Drop Shot Frequency

Figures 13 and 14 signify that none of the variables were significantly associated with the set outcome. The total forehand net drop shots played had a coefficient of -0.18, indicating a slight negative association with the odds of winning a set, meaning that higher frequencies were associated with marginally lower chances of winning. Still, these relationships are not statistically significant ($p>0.05$). Similarly, backhand net drops, forehand over-the-head drops, and backhand over-the-head drop shots were all statistically not significant ($p>0.05$).

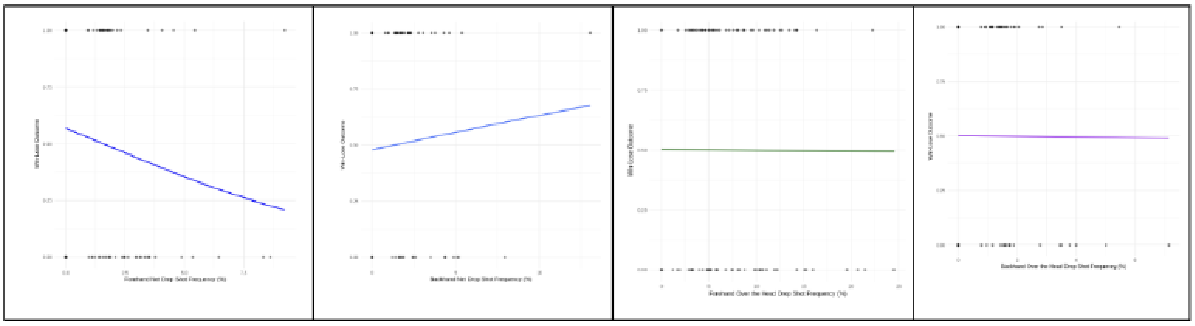

Figure 13. Logistic Regression Models for Drop Shot Frequencies Out of Total Shots

	β	SE	p-Value	Odds Ratio
% Total Net Drops and Drop Shots	0.00	0.03	1.00	1.000
% Total Forehand Net Drop Shots	-0.18	0.11	0.12	0.84
% Total Backhand Net Drop Shots	0.06	0.10	0.562	1.06
% Total Forehand Over-the-Head Drop Shots	0.00	0.04	0.92	1.00
% Total Backhand Over-the-Head Drop Shots	0.00	0.15	0.98	1.00

Figure 14. Logistic Regression Results for Drop Shot Subtypes and Set Outcome Out of Total Shots Played

Figures 15 and 16 show the same statistical results through simple logistic regression, but where subtype frequencies were calculated out of total drop shots rather than total shots played. Similar to the results in Figures 13 and 14, the results were statistically insignificant. Although forehand net drop shots ($\beta = -0.02$, $p = 0.13$) had a negative coefficient and forehand over-the-head drop shots ($\beta = 0.01$, $p = 0.11$) had the largest positive coefficient, demonstrated by a positive and negative regression slope, respectively, the association was not statistically significant ($p>0.05$).

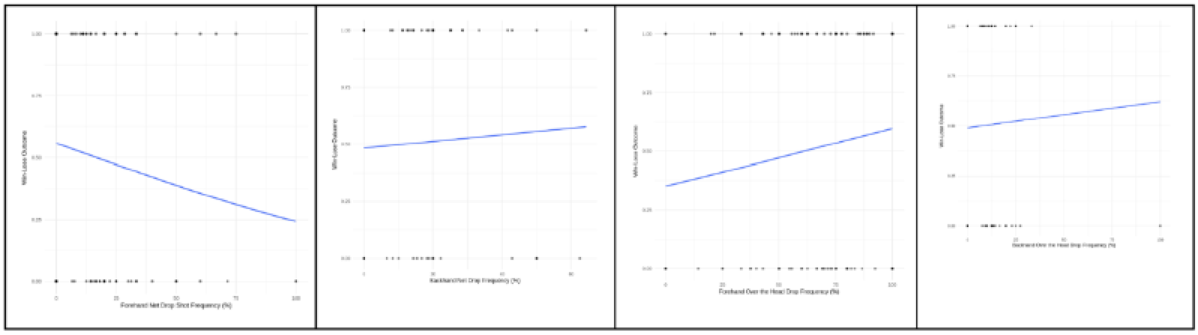

Figure 15. Logistic Regression Models for Drop Shot Frequencies Out of Drop Shots

	β	SE	p-Value	Odds Ratio
% Total Forehand Net Drop Shots	-0.02	0.01	0.13	0.98
% Total Backhand Net Drop Shots	0.00	0.01	0.81	1.00
% Total Forehand Over-the-Head Drop Shots	0.01	0.01	0.11	1.01
% Total Backhand Over-the-Head Drop Shots	0.01	0.02	0.70	1.01

Figure 16. Logistic Regression Results for Drop Shot Subtypes and Set Outcome Out of Total Drop Shots Played

RESULTS

Across all simple logistic regression models, neither total drop shot frequency nor any individual subtype demonstrated statistically significant results, with no p-values less than 0.05, and the odds ratios close to 1. This indicates that changes in frequency produced minimal to no change in the odds of winning the set.

These results demonstrate that drop shot frequency alone is not associated with set outcome in the 2024 women's doubles KAIAC Badminton Championships. Research by Blomqvist et al. explains these results as elites are more experienced and have a better understanding of the game (Blomqvist et al., 2000). The frequency of the shots may not have any intent or chances of association for the players in this specific population. Therefore, shot frequency alone may not be the determining factor in the association with the win-lose of a set.

Descriptive statistics indicated smaller variability with narrower interquartile ranges among winning sets. However, the cluster did not transfer to statistically significant results in the logistic regressions. Connecting to Blomqvist et al., the results may be because the playing ability of the participants is not uniform, resulting in a slightly smaller interquartile range among winning sets, where players are more likely to have a greater depth of knowledge (Blomqvist et al., 2000).

These results diverge from previous studies with elite populations by Abián et al. and Abian-Vicen et al., as their findings indicated that net drops frequently ended rallies in many cases (Abián et al., 2014; Abian-Vicen et al., 2013). However, drop shot frequencies may serve other purposes with the presence of contextual variables.

The null findings create tension between existing literature and the present study, as intentions described by the researchers do not apply to this particular non-elite population (Macquet & Fleurance, 2007). In fact, non-elite players may not use drop shots with the same strategic intent or technical precision. Therefore, this difference suggests that theories developed from elite performance may not be directly generalizable to the non-elite population. In fact, the function of drop shots may depend on contextual factors rather than the quantity itself. The opponent's position and the pace of the set may hinder the impact of drop shots. The opponent being far away from the net is likely to indicate a drop shot, which falls right in front of the net.

The findings of this study are significant because they challenge and refine the tactical understandings and assumptions about non-elite athletes in badminton research. With no specific statistical correlation between shot types and shot outcomes, the results demonstrate that there may be a different shot type that associates with winning, other than a certain frequency of drop shots. Therefore, this study is significant to existing literature by suggesting that tactical models developed from elite badminton may not apply to non-elite badminton players.
To a certain extent, this study addresses the limitation of the study by Chiminazzo et al., in which individual shots were not analyzed, filling in limited research in specific shot subtypes and their correlation with set outcomes (Chiminazzo et al., 2018). By statistically analyzing each subtype independently, this research

connects to previous studies by responding to the call for subtype-level research (Pérez-Turpin et al., 2020; Sheng et al., 2022).

While prior studies emphasized the importance of choosing a particular shot for elite players, this study demonstrates that drop frequency alone does not associate with set win-lose outcomes in this population. The gap in research for non-elite girls' doubles and the association between the frequency of a specific subtype are partially addressed in this research. In fact, the association between drop shot usage and winning appears limited. The results indicate that the association may relate more to timing, placement, and set phase. It is unknown whether the frequency of other shot types indicates a correlation with winning sets.

LIMITATIONS

Despite the number of shots analyzed in the study, some limitations need to be addressed. One such limitation is the observer classification error. This possibly occurred due to two different reasons, despite each drop shot subtype being defined and confusing shots being checked with multiple coaches. First, the data were collected and categorized through a human eye, leading to potential observer classification error while converting observational data into quantitative data. Also, one observer conducted the coding. Initially, multiple observers were planned. However, constraints in recruitment prevented the inclusion of additional coders, as the study relied on voluntary participation from badminton experts with at least three years of playing experience. The lack of compensation for the extensive coding process limited further participation. Therefore, the inter-rater reliability could not be calculated, limiting the reliability. Other researchers, such as Hughes and Pérez-Turpin et al., calculated this matter in order to determine the validity of each of their observers, intending to eliminate observer classification error (Hughes, 2004; Pérez-Turpin et al., 2020). Overall, the limitations in classification may result in biased frequencies with inconsistencies in distinguishing similar shots. This can potentially alter associations. To address this limitation, future research can use the inter-rater reliability test that multiple researchers have utilized to ensure consistency (Hughes, 2004; Pérez-Turpin et al., 2020).

The availability of footage influenced the application of this study, as the sample was restricted to a single tournament from a single year. This limits the population that the results can apply to, as factors such as different coaching styles and players could produce significantly different results in other non-elite settings, even with different KAIAC years.

Limitations exist in the utilization of available video footage rather than motion tracking, like Hsu and colleagues (Hsu et al., 2024). Camera angles occasionally limited the observer's ability to see the entire court. Moreover, classifying each shot through machine learning was not possible due to the video quality of the 2024 KAIAC championships, as a high video quality is required to do so. The particular limitation restricted precise tracking, raising errors in the categorization of shot placement and hindering the reliability of the research, as previously mentioned with the observer classification error.

CONCLUSION

Initially, the study hypothesized that higher frequencies of drop shots, particularly net drops, would be positively associated with winning sets. However, the results indicate that frequency alone does not predict set outcomes in the 2024 KAIAC girls' varsity doubles. The descriptive results suggested that winning sets will be associated with more consistent shot distributions. However, this study found that there was no association between drop shot frequency of different subtypes and set win-lose outcomes in girls' doubles at the 2024 KAIAC badminton championships. No p-values were less than 0.05. In fact, the results suggest that drop shot frequency alone does not associate with set outcomes in this particular population. Simply utilizing more drop shots was not associated with the win-loss of the set.

IMPLICATIONS

As previously stated, the emphasis in strategic decisions from previous studies (Macquet & Fleurance, 2007; Chiminazzo et al., 2018) did not apply the same within a non-elite women's doubles population, as demonstrated with no statistical significance ($p>0.05$). The results of this study can trigger coaches working with varsity-level athletes to alter their coaching strategies if necessary in order to lead their teams to win sets, and, ultimately, win matches and tournaments. Specifically, the study's results can encourage coaches of girls' doubles teams participating in the KAIAC games to focus less on performing the drop shot itself. Instead, coaches can try to put the shots into different contexts by being their opponent. Girls' doubles coaches can let their players choose a shot that would be best for the situation, which can be a drop, smash, or a clear in different locations.

Therefore, coaches can design their training to consider improving players' awareness of the context of the rally through simulating matches. Coaches can also consider training the players to improve the quality and accuracy of their shots by consistently providing the same situation for the players. Overall, this stimulates the coaches to avoid the repeated use of a specific drop shot subtype, aligning with the data results that signified the insignificance of frequency itself.

With these coaching tactics, the shots that KAIAC girls' doubles perform can rely on contextual and technical variables rather than solely considering an excess or lack of drop shots. In fact, KAIAC girls' doubles players are not pressured to perform the drop shot to continue winning, even when the situation of the set might not be in favor of one. This corresponds with the relatively high standard deviation of the frequencies for both winning and losing sets, as players do not focus on the frequency of their drop shots but rather focus on the context.

Furthermore, this research suggests that sports analysts who intend to incorporate data departments at non-elite levels should consider analyzing contextual variables rather than tactical variables (Sheng et al., 2022).

However, these implications are limited to non-elite varsity-level girls' doubles badminton players and are not generalizable to elite players or singles players. In all, this particular study is significant because the stakeholders involved can improve their understanding of shot frequencies in non-elite levels.

FUTURE STUDY

The limitation in time and resources can be improved through a longitudinal study conducted over multiple seasons. With a larger sample size, the validity of the research and the method itself can be enhanced, similar to the longitudinal study of the Olympics done by other researchers (Abian-Vicen et al., 2013; Cenan & Pamuk, 2022).

Next, the particular shots can be researched to determine whether the quantity of other shot types is related to game outcome in the non-elite population, since this particular study solely focused on drop shots and found no significant statistical results. Through the examination of multiple shots, further studies can research the association between the quantity of multiple different shot types and set outcomes.

Furthermore, this study posed a possible significance regarding contextual variables such as timing and location of the shot in the 2024 KAIAC girls' badminton. In relation to contextual variables, further research can test the validity of this possibility with a non-elite population (Sheng et al., 2022).

Moreover, scholars can research different categories in the 2024 KAIAC Badminton, such as men's singles, men's doubles, girls' singles, and mixed doubles. Since the non-elite population necessitates more scholarly attention, future studies in the same tournament can elevate the perspective of the non-elite badminton population.

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