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Investigating Performance Dynamics of Pakistan's T20 Middle-Order Batsmen Using Survival Analysis

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Abstract

This study examines the performance of Pakistan's middle-order batsmen in T20 Internationals. The middle-order remains a critical concern for Team Pakistan, as wickets are falling at an accelerated rate. Data were sourced from ESPNcricinfo, covering T20 matches from 2020 to 2024, including 12 players across 249 innings. Survival analysis techniques were applied, including the Kaplan-Meier (KM) method, Cox proportional hazards model, and the Log-Rank Test. The KM analysis reveals that Asif Ali and Iftikhar Ahmad excel in terms of strike rate, while Fakhar Zaman, Shoaib Malik, and Shadab Khan stand out for total runs. Players demonstrating greater resilience at the crease include Haidar Ali, Fakhar Zaman, Imad Wasim, and Shoaib Malik. In the Cox-Proportional Hazard Model (Cox-PH), all statistical tests yield significant $p - values$ Likelihood Ratio Test (LRT), Wald Test, and Log-Rank Test highlighting the model's robustness. Iftikhar Ahmad and Shan Masood spent the most time at the crease, while Fakhar Zaman, Iftikhar Ahmad, Shoaib Malik, and Shadab Khan faced the most deliveries. The Log-Rank Test reveals a significant difference in performance based on average runs ($p = 0.01$), but not on strike rate ($p = 0.35$). These insights can support data-driven player selection and middle-order strategy for Pakistan's T20 team.

Keywords: *Game of Cricket, T20 International, Middle-Order batting, Kaplan Meier (KM) Curves, Cox-Proportional Hazard Model (Cox-PH), Log Rank Test*

1. Introduction

Originating in the southern England in the $16th$ century, cricket has become a popular sport. According to a report by ESPNcricinfo.com and other sports authorities, an estimated more than three billion people around the globe follow cricket with great passion and excitement. Currently international cricket is composed of three formats: Test cricket, which dates back to 1871, with the first official Test match played at the Melbourne Cricket Ground (MCG); One-Day Internationals (ODIs) which were introduced in 1971 and also took place at the MCG between Australia and England; and the most recent, fast-paced format, T20 Internationals that began in 2005. In all three formats, each team comprises eleven players, with one designated as the captain, and in some teams, a vice-captain is also appointed to support the captain. The start of a match for all formats is similar, beginning with a coin toss on the pitch. The captain who wins the toss has the choice of either batting first or fielding, thus sending the opponent team to either bat or field first. However, the match duration and structure vary across formats. Test cricket spans five days, with two innings for each team, and around 90 overs played daily, including a tea break and a lunch break. ODIs consist of fifty overs per team, with the first ten overs referred to as the powerplay, during which only two fielders from the fielding side are allowed outside the 30-yard circle, which is approximately 27.4 meters from the pitch. In contrast, T20 matches consist of 20 overs per side. In the T20 format, the powerplay lasts for six overs, during which only two fielders can be positioned outside the 30-yard circle. After the powerplay, a maximum of five fielders may be outside the circle for the remaining overs. The first T20 International match was played on February 17, 2005 between New Zealand and Australia at the Hampshire Cricket Stadium. The governing body for international cricket, the International Cricket Council (ICC), organizes major tournaments for each format, such as the ODI World Cup, the T20 World Cup, the Test Championship, and the Champions Trophy. Bilateral series between countries are also frequently arranged, with teams competing against each other. Various authors have studied cricket, analyzing the performance of different teams and players in Test, ODI, and T20 formats. For example, [1] investigated whether winning the toss or having a home advantage impacts ODI matches. They concluded that, unlike T20 cricket, ODI matches do not significantly favor the team that wins the toss, though home advantage may offer a slight edge due to crowd support. They also analyzed the rating teams and the outcome in both test and one-day international cricket. A two-stage regression OWA method was used by [2] for measuring the different

parameters related to batsman performance. [3] developed a comprehensive method in 2003, later used to analyze player performance using data from the 2007 World Cup. In limited-overs formats, [4] emphasized the importance of selecting batsmen using certain criteria, comparing their selection based on various dimensions. [5] evaluated whether winning the toss has any effect on the match or provides an advantage to either team. [6] used different charts including individual range and moving range to analyze the performances of cricket scores for team Pakistan. [7] examined various aspects of T20 cricket including batting, bowling and fielding as a generating valuable to conclude the success of matches in T20 cricket specifically focusing on the ICC Cricket World cup 2009. [8] evaluated player performance in ODIs using the Duckworth-Lewis method. [9] investigate batting and bowling performance metrics, and also utilized pitch-level analysis to pinpoint detailed variables associated with successful match outcomes. [10] quantified individual achievements in cricket, focusing specifically on batting and bowling performances, based on runs and wickets. [11] made significant contributions to cricket research derived from 2007 T20 world cup, particularly studying the impact of the powerplay on both batsmen and fielding sides. Their analysis concluded that taking wickets for the fielding side or hitting boundaries for the batting side during the powerplay is crucial and has a significant effect on the match's outcome.

Similarly, follow-on decisions and declarations in Test cricket were analyzed by [12] . [13] used double sampling strategy techniques to estimate population mean. Additionally, [14] employed logistic regression and maximum likelihood estimation to model and predict match outcomes in ODI cricket. Furthermore, [15] analyzed T20 cricket using a factor analysis approach, with the primary goal of comparing the performance of batsmen and bowlers. Based on this study, Sharma concluded that batting prowess clearly outweighs bowling ability in T20 cricket.

For instance, based on integer optimization [16] conclude that, which reason the players should need to be selected for the T20 cricket, and quantify players' abilities to score runs and take wickets, using data from the inaugural T20 World Cup held in South Africa in 2007.
While [17] developed a model to analyze player performance and predict the outcome of batsmen in test cricket. Similarly, [18] used the strategy of double sampling stratification with non-response simultaneously to estimate mean of population. Several authors have also explored different techniques for assessing the performance of T20 teams and players.
Although recurring challenges exist, there remains a lack of empirical evidence explaining the reasons why Pakistan's middle-order repeatedly fails to deliver reliably in T20 cricket. This research work addresses that gap by utilizing survival analysis to reveal not just what happens during innings, but in which situation of the match the player performance breaks down under pressure.

Consequently, the primary investigative of this research study is: How can survival analysis approaches be used to evaluate and interpret the performance dynamics of Pakistan's middle-order batsmen in T20 cricket? To address this problem, the study outlines the following objectives:

- To measure key performance metrics such as runs, strike rate, balls faced, and time spent at the crease.
- To implement the Kaplan-Meier (KM) method, Cox-PH model, and Log-Rank Test to model and compare player resilience and effectiveness.
- To identify players, who demonstrate consistency under match pressure.

2. Data and Methodology

2.1 Data:

To evaluate the performance of Pakistan's middle-order batsmen in T20 International cricket, we collected data from ESPNcricinfo by navigating to Stats/Stats guru/T20's/ Batting/Advanced Filter. In the advanced filter, we input the details to collect data of players' innings by innings. The obtained data comprised almost four years, i.e. from January 1, 2020, to September 30, 2024, during which a total of 29 players played their innings at middle-order positions. Among these players, a few were not proper middle-order batsmen, such as tail-enders or players who played just two or three innings. Therefore, we eliminated the tail-enders because they came early for batting in some matches but are not proper middle-order batsmen. Similarly, we also excluded players who played fewer than five matches, as based on two or three innings, their performance couldn't be evaluated to decide whether they would perform better in the future. Additionally, retired players were not included in our study and analysis as they are not available for selection to play for Pakistan.
For our study and analysis, a total of 12 players who played 249 innings for Pakistan at middle-order positions were selected. Each of these players has played more than five innings. They are considered proper middle-order batsmen and are still available for selection to play at middle-order positions for the Pakistan team.

2.2 Methodology:

In this research study, we used different survival analysis approaches; each approach has its own assumptions. Therefore, we considered various features of players such as runs, strike rate (SR), balls faced (BF), minutes spent at the crease (Mins), etc., according to these assumptions. The selection of survival analysis methods is aligned with the study's focus on time-to-event data, specifically modeling player batting longevity and performance during innings. The KM method is used for estimating the survival probabilities over time, while the Cox-PH model measures the consequences of player-specific covariates, and the Log-Rank test is specifically chosen to compare performance between groups, due to the fact that runs scored and strike rate are the key indicators in this research study.

The different approaches we used for analyzing the performance of players are explained one by one, along with the results and plots. However, before that, we obtained the individual performance of each player. In each method, we analyzed and assessed the performance of team Pakistan's middle-order batsmen in T20 international cricket. To support reproducibility, the dataset used in

this study is available at: https://zenodo.org/records/14748727. The summary table is linked with each survival analysis method to the corresponding research objective.

In Table 1, the statistical overview for each player is derived from the data, which includes player innings, total runs, average runs, average strike rate, and other relevant metrics. These summaries are used in each survival analysis approach to evaluate player performance. Additionally, for a comprehensive statistical overview, we created various figures based on the aggregate data of all players to enhance clarity.

Table 1: Summary of Middle-Order Batting Performance Metrics for Each Player

Player	Innings	Runs	Avg Runs	Avg SR	Median	Min	Max	SD
Asif Ali	26	244	9.38	129.06	7	0	27	8.83
Azam Khan	13	88	6.77	95.94	2	0	30	9.04
Faheem Ashraf	11	96	8.73	106.32	4	1	30	10.90
Fakhar Zaman	20	488	24.40	140.78	17	0	78	21.00
Haider Ali	18	224	12.40	111.79	6	0	68	16.70
Iftikhar Ahmed	48	788	16.40	112.44	13.5	0	51	13.60
Imad Wasim	19	261	13.70	123.42	11	1	64	14.80
Khushdil Shah	22	321	14.60	99.84	13	0	36	11.50
M Nawaz	26	397	15.30	134.53	10.5	0	45	13.70
Shadab Khan	32	473	14.80	105.37	9	0	52	15.40
Shan Masood	7	151	21.60	107.56	12	2	65	23.10
Shoaib Malik	7	172	24.60	123.25	19	0	58	23.40

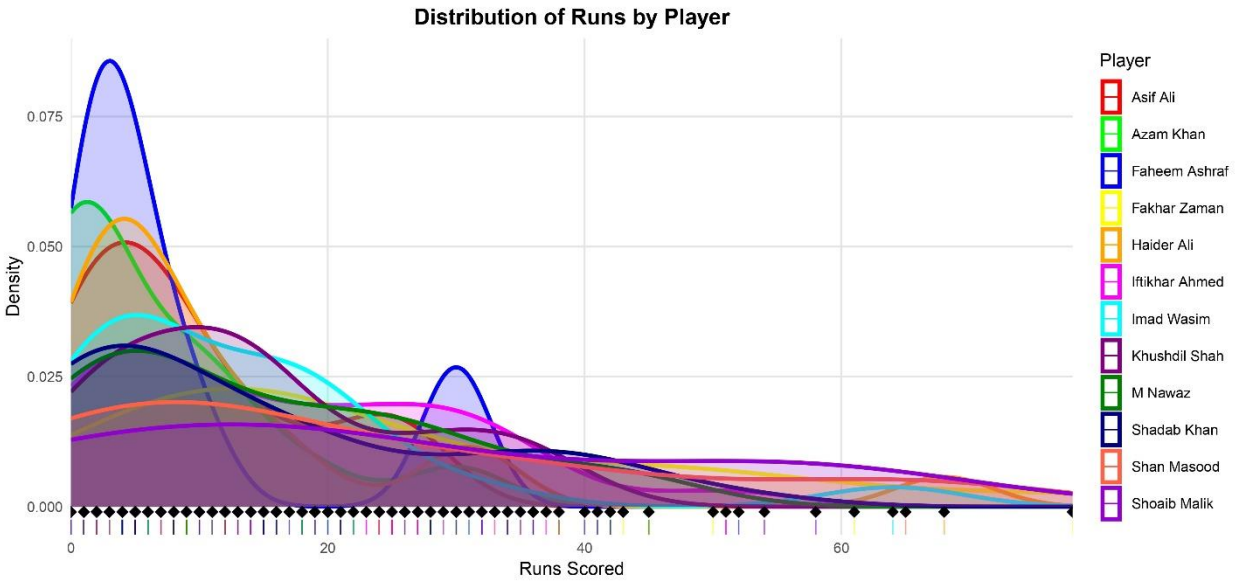

Figure 1: Performance Based on Runs for Each Player

Figure 1 illustrates the distribution of runs scored by different players. Each curve represents the density of scores for an individual player, showing how frequently particular run values occur. The plot highlights that most players tend to score lower runs more often, with a long tail extending towards higher scores. The overlapping densities allow comparison of scoring patterns between players.

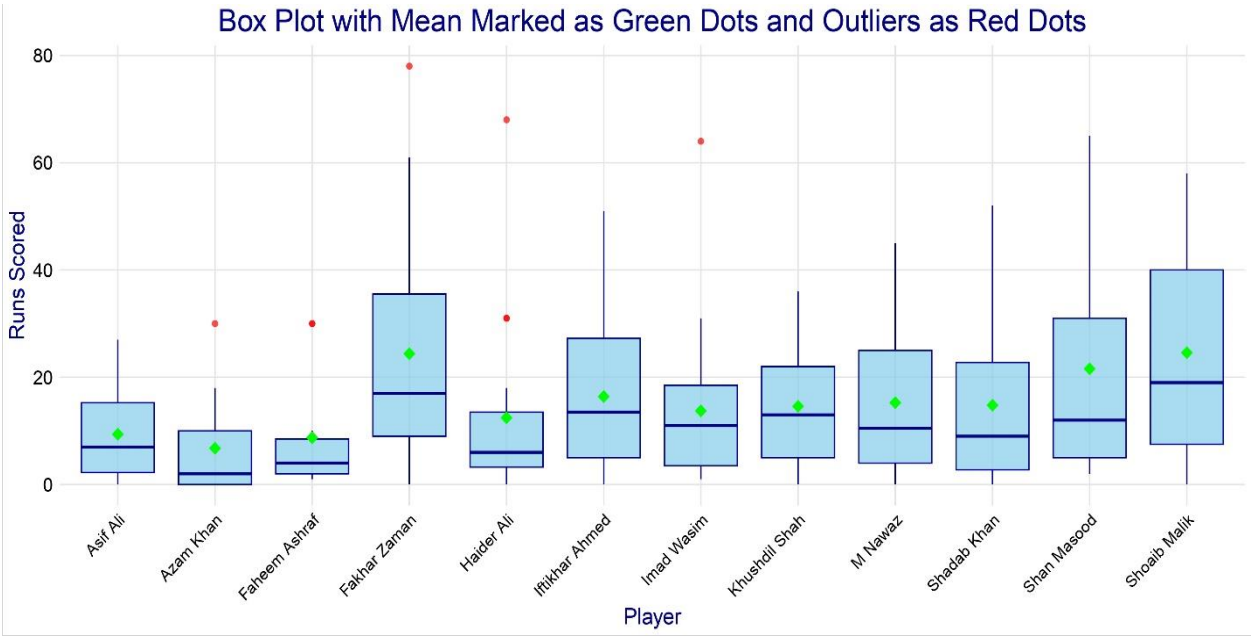

Figure 2: Box Plot Highlighting Outliers and Mean Values

Figure 2 box plot reveals that players like Fakhar Zaman, Shoaib Malik, and Shan Masood consistently score higher runs, as indicated by their elevated medians and means. In contrast, Azam Khan, Faheem Ashraf, and Asif Ali exhibit lower run distributions, suggesting comparatively weaker performances. Notably, the presence of outliers for players such as Fakhar Zaman and Shoaib Malik highlights their potential to deliver impactful high-scoring innings.

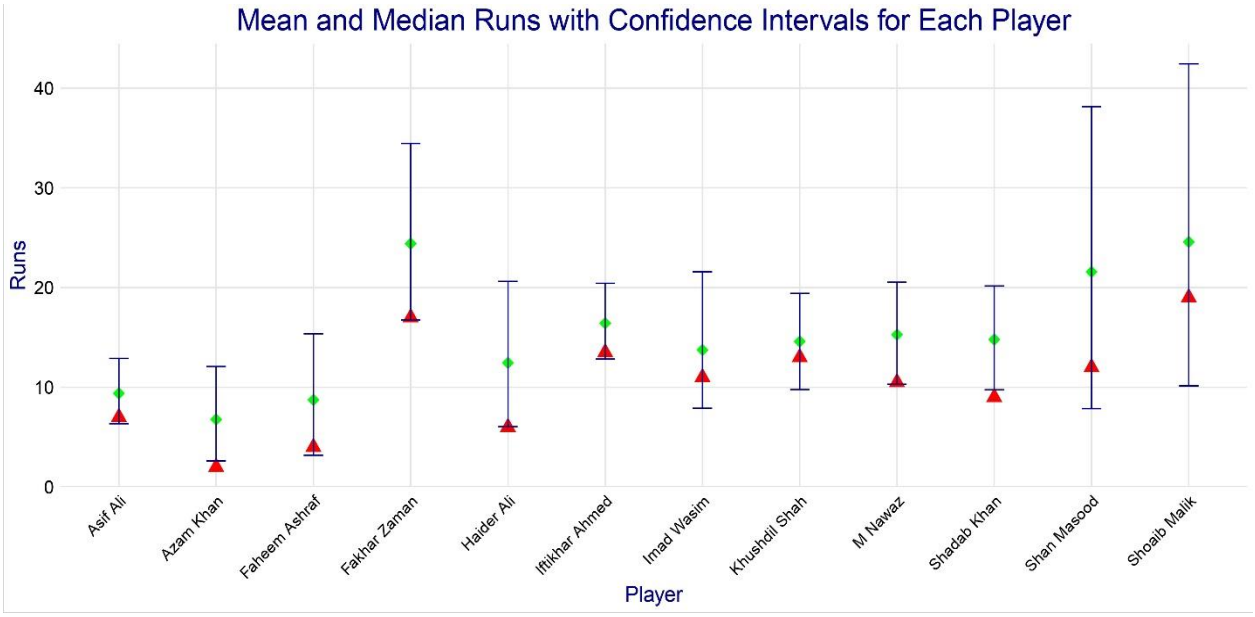

Figure 3: This plot shows the mean and median runs scored by each player, represented by green diamond shaped points for the mean and red triangle-shaped points for the median. Error bars represent the 95 percent confidence intervals for the mean runs

The aforementioned Figure 3 illustrates both the average and median runs of each player, with error bars showing the confidence intervals. Players like Fakhar Zaman, Shoaib Malik, and Shan Masood display consistently higher central tendencies, reflecting stronger batting contributions. In contrast, Azam Khan, Faheem Ashraf, and Asif Ali have notably lower values, indicating relatively limited scoring performance across matches.

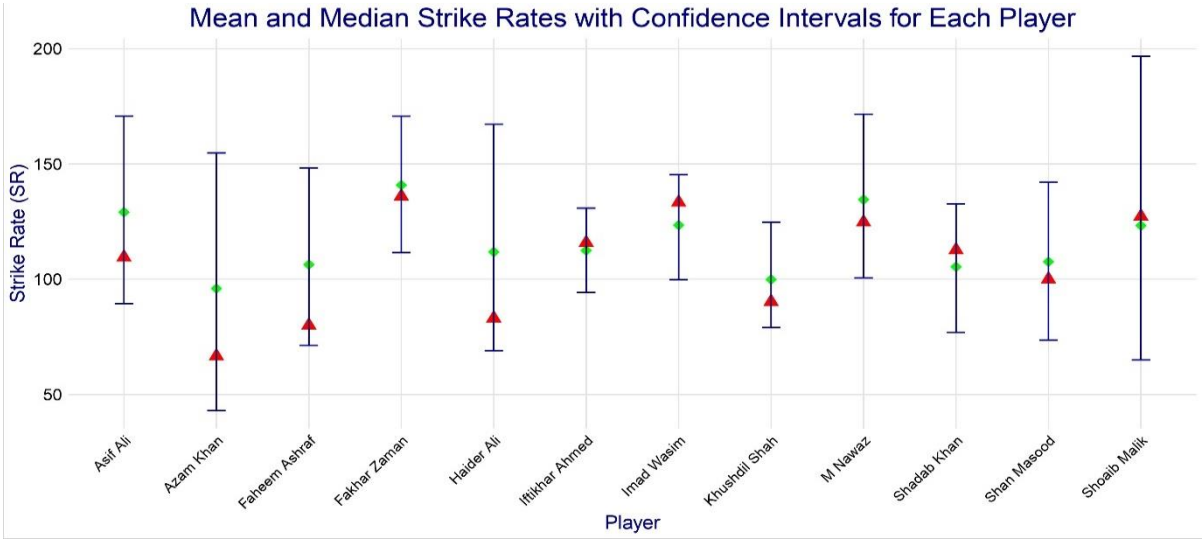

Figure 4: Comparison of average and median strike rates (SR) for each player. Green diamond-shaped points indicate the mean strike rate, red triangle-shaped points denote the median strike rate, and blue error bars represent the 95 percent confidence intervals for the mean

The above Figure 4 presents the average and median strike rates for each player, along with their corresponding confidence intervals. Fakhar Zaman, Imad Wasim, and Shoaib Malik exhibit relatively superior scoring tempos, indicating their aggressive batting styles. Conversely, Azam Khan and Faheem Ashraf show lower pace metrics, reflecting more conservative or inconsistent strike patterns.

2.2.1 Kaplan-Meier (KM) Method:

The Kaplan-Meier (KM) Method is an effective technique, specifically use for estimating the survival function. KM is also known as the product limit estimator and is a non-parametric statistic. Therefore, this method does not assume parameters like probability distributions. KM can be widely applied in various fields, including health, for example, time from COVID-19 diagnosis or cancer diagnosis to death or loss to follow-up (days, months, years). The event can be death, and we can assign numbers such as 1 if the patient died or 0 if censored, i.e. survived.

In the KM analysis, the survival time variable represents the duration a batsman remains at the crease before dismissal. This is measured in two forms depending on context: (i) Balls Faced (BF) representing the count of deliveries faced, and (ii) Minutes (Mins) representing time spent at the crease. The event of interest is 'dismissal' (coded as 1), while 'not out' innings are treated as censored observations (coded as 0).
To compare the performance of players using the KM method, we consider two key aspects: Runs Scored and Strike Rate, both of which are crucial in T20 cricket due to the limited overs and faster gameplay compared to other cricket formats. Based on these two aspects, we assess the players' performance, as shown below.

Kaplan-Meier Curves Depicting Batsmen Performance in Relation to Runs Scored:

To obtain the survival curves, we analyzed the survival time and survival status of players. The variable for survival time represented the scores for each player's innings, while the survival status indicated whether the player was out (event) or not out (censored). A censored observation refers to a player who did not get out, while an event represents a player who was out. In R software, the libraries used for generating the KM curves are as follows:

install. packages (" survival")
library(survival)
install. packages (" survminer")
library(survminer)

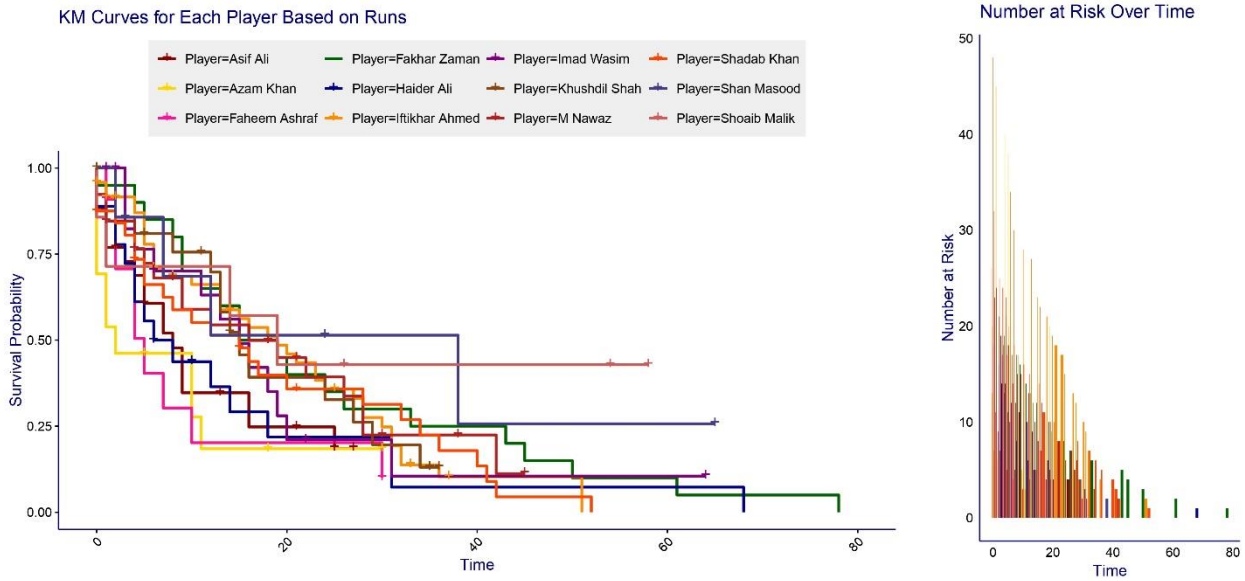

Figure 5: Kaplan Meier Curves along with Number at Risk for each player Based on Runs Scored

In Figure 5, the survival curves and number at risk based on runs are shown for each player using the KM method, a widely used and easy-to-understand approach. In the figure, the y-axis represents the survival probabilities, illustrating how each player's probability changes as they score runs, shown on the x-axis. In terms of scoring runs, Fakhar Zaman, Shoaib Malik, Shadab Khan, and Haider Ali are key players for Team Pakistan at the middle-order batting positions, performing significantly better compared to other players in T20 international cricket.

Kaplan-Meier Curves Depicting Batsmen Performance in Relation to Strike Rate (SR):

To construct the survival curves, we utilized the necessary tools and prepared the survival data. The survival time and status variables were converted into a specialized survival object, which was subsequently employed to model survival. The details regarding the dataset and status variable are described in detail in the Data and Methodology section.

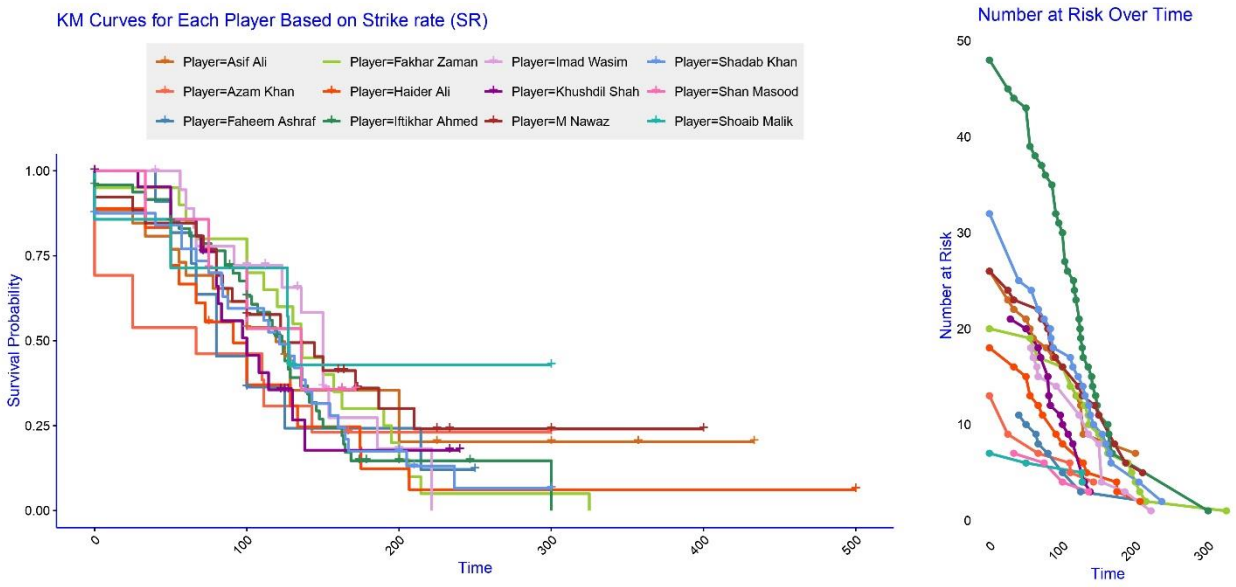

Figure 6: Kaplan Meier Curves along with Number at Risk for each player Based on Strike Rate (SR)

The above Figure 6 provides a comprehensive comparison between the survival curves and the number at risk, focusing on strike rate. For middle-order batsmen, maintaining a high strike rate plays a crucial role in securing victories for their team. The plot highlights the exceptional strike rates of Haidar Ali, Asif Ali, Fakhar Zaman, Iftikhar Ahmed, Shoaib Malik, and M. Nawaz. Due to notably high strike rates these players, while representing Pakistan in T20 international cricket in middle-order positions, have showcased remarkable performance. The analysis emphasizes that these six players are standout performers, capable of finishing matches with a win. Therefore, they should be prioritized over others for middle-order roles.

Kaplan-Meier Curves: Player Survival Probability to face another ball:

In this section, our main goal is to delve into a more traditional and detailed analysis of the survival patterns of middle-order batsmen while they are at the crease. This investigation focuses on their ability to stay at the wicket and face the next ball, which is a critical factor in determining their overall contribution to the team's success and chances of securing a victory. The plot serves as a valuable visual tool, enabling us to compare the probability of survival for each batsman at the crease, specifically their likelihood of remaining in play to face the next delivery, thereby highlighting individual performance.

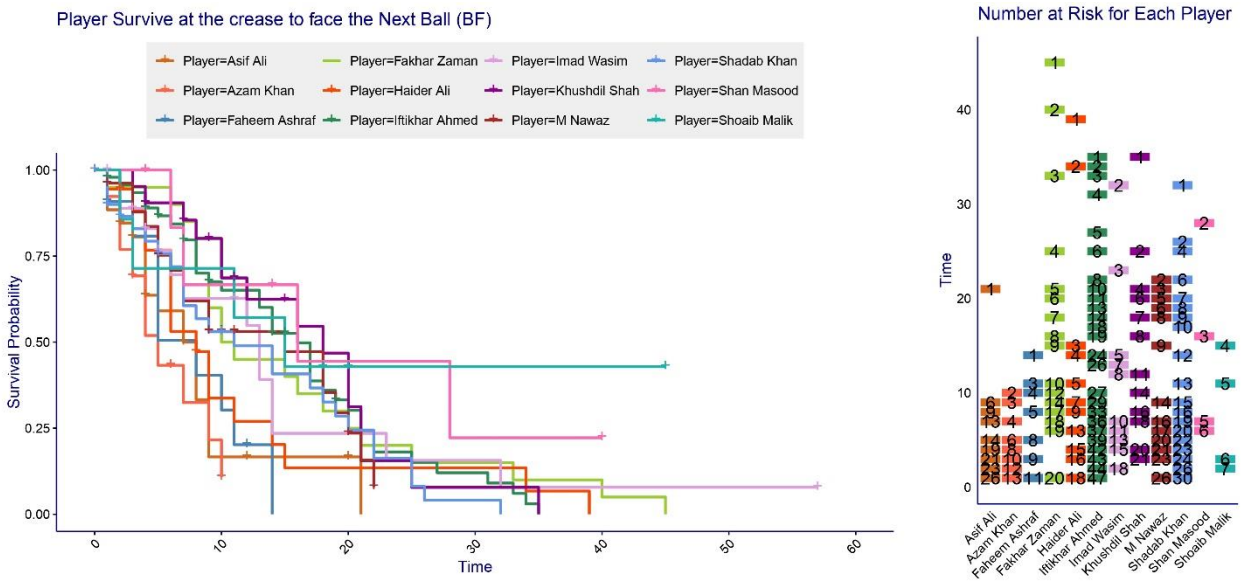

Figure 7: KM Curves and Number at Risk to Face Next Ball by Each Player

From the obtained KM curves and the number at risk for each player in Figure 7, it is clearly shown and easily understandable that Imad Wasim, Fakhar Zaman, Shoaib Malik, Haidar Ali, and Shan Masood are the top players who demonstrate a high capability to remain at the crease and face the next delivery without being dismissed. In contrast, the rest of the players are at a higher risk of losing their wicket. Therefore, players who can protect their wicket when facing the next ball are highly recommended for middle-order batting positions in T20 international cricket for Team Pakistan.

2.2.2 Cox-Proportional Hazard Model (Cox-PH):

In survival analysis, like the Kaplan-Meier (KM) method, the Cox proportional hazards model assumes that hazard ratios remain constant over time this is known as the PH assumption. To ensure the validity of the model, this assumption should be verified using diagnostic methods such as Schoenfeld residuals. Unlike the KM method, the Cox-PH model allows investigation of the effects of multiple variables on the time until a specified event occurs, such as a player getting out in cricket.

The Cox-PH model assumes that covariates have a multiplicative effect on the hazard, and that the hazard function maintains a constant ratio over time. The survival function in this context is often modeled exponentially, such as $S(t) = exp(-\lambda t)$, consistent with the PH assumption, where t represent time (the time until an event occurs, e.g., failure time and λ denote the rate parameter. The Cox-PH can be expressed as follows:

$$h(t \mid X) = h_o(t) \cdot exp(\beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_p X_p)$$

where, $h(t|X)$ is the hazard function at time for given covariates $X_1, X_1, \ldots, X_p$ and $h_o(t)$ is the baseline hazard function, and $\beta_1, \beta_2, \ldots, \beta_p$ are the regression coefficients, which represents the influence of each covariate.

The hazard ratios, $exp(\beta_i)$, quantify the relative risk of the event occurring given a one-unit increase in the corresponding covariate.

In this study, we used two-time variables for the Cox-PH model: Minutes spent at the crease (Mins) and Balls faced (BF) until dismissal (event coded as 1) or censoring (not out, coded as 0). These time metrics provide different, but complementary perspectives on player survival in the game. The results and plots are presented below.

Table 2: Cox-PH Model Results Using Mins as Time Variable

Player	Coef	exp (Coef)	exp (-Coef)	se (Coef)	Lower 0.95	Upper 0.95	z	$p\ (>\|z\|)$
Azam Khan	0.464	1.591	0.628	0.393	0.735	3.444	1.18	0.23811
Faheem Ashraf	-0.051	0.949	1.053	0.405	0.428	2.101	-0.13	0.89810
Fakhar Zaman	-0.785	0.455	2.194	0.328	0.239	0.868	-2.39	**0.01688***
Haider Ali	-0.404	0.667	1.498	0.353	0.333	1.334	-1.14	0.25269
Iftikhar Ahmed	-0.748	0.472	2.114	0.287	0.269	0.830	-2.61	**0.00907****
Imad Wasim	-0.723	0.485	2.060	0.366	0.236	0.996	-1.97	**0.04873***
Khushdil Shah	-0.780	0.458	2.181	0.348	0.231	0.907	-2.24	**0.02511***
M. Nawaz	-0.735	0.479	2.085	0.332	0.250	0.919	-2.21	**0.02698***
Shadab Khan	-0.617	0.539	1.854	0.307	0.295	0.984	-2.01	**0.04443***
Shan Masood	-1.533	0.215	4.633	0.557	0.072	0.644	-2.75	**0.00598****
Shoaib Malik	-0.908	0.403	2.480	0.552	0.136	1.190	-1.64	0.10021

Table 3: Statistical Test Results

Test	Results
Concordance	**0.604** (Standard Error = 0.023)
Likelihood Ratio Test	**22.75** on 11 df, **p = 0.02**
Wald Test	**24.49** on 11 df, **p = 0.01**
Score (Log rank) Test	**26.49** on 11 df, **p = 0.005**

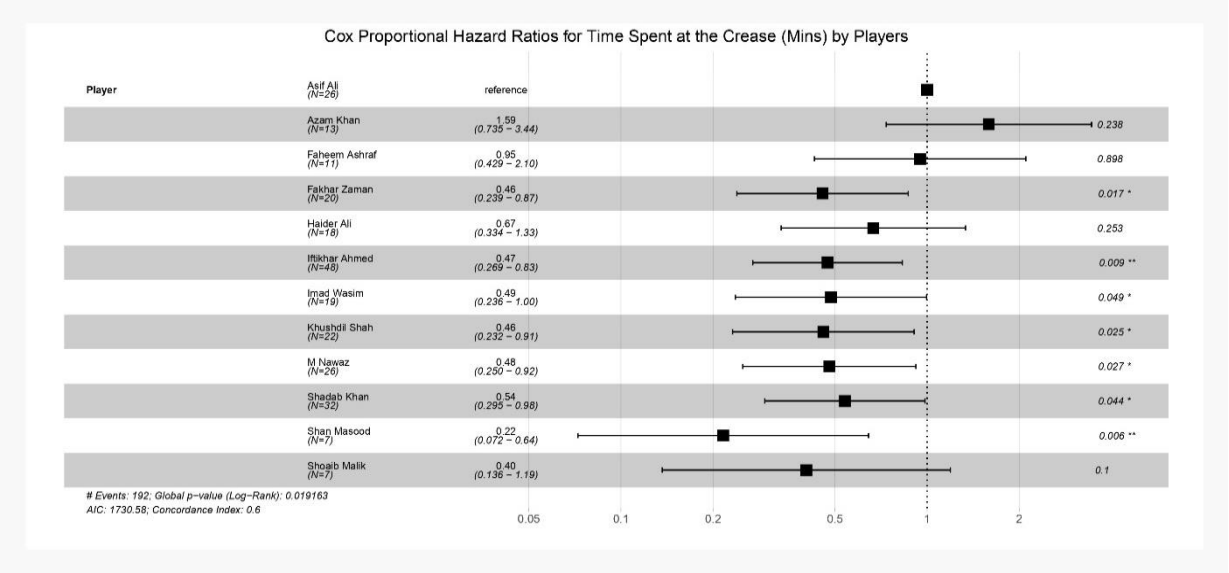

Figure 8: Cox-PH Model, Hazard Ratios Assessing Players' Minutes Spent at the Crease.

By using minutes as the time variable in the Cox-PH model, the detailed results we obtained are presented in Table 2. For each player, the estimated hazard ratio (HR) is obtained. A lower hazard ratio HR indicates that a player has a reduced risk of dismissal per unit increase in time spent at the crease. Practically, this means such players are more consistent and dependable, making them strong candidates for selection in roles requiring stability, especially in the middle-order. Selecting players with lower HRs can enhance team resilience during critical phases of the innings, its 95% confidence interval, the $z - statistic$, and corresponding $p - value$ ($Pr(>|z|)$) are reported. These HRs provide a direct interpretation of relative risk, indicating how a player's risk of the event (e.g., dismissal) compares to a baseline. From the results, we observe that Iftikhar Ahmed ($HR = 0.009$) and Shan Masood ($HR = 0.006$) exhibit highly significant effects, as indicated by their low $p - values$ ($p < 0.01$), suggesting a strong association between their playing time and survival outcomes. In

addition, Fakhar Zaman ($HR = 0.017$), Imad Wasim ($HR = 0.049$), Khushdil Shah ($HR = 0.025$), M. Nawaz ($HR = 0.027$), and Shadab Khan ($HR = 0.044$) also show statistically significant effects at the 5% level, though less pronounced than those of Iftikhar Ahmed and Shan Masood.

These findings imply that these players, especially Iftikhar Ahmed and Shan Masood, are associated with a lower hazard of dismissal per unit increase in time spent at the crease, as reflected by their hazard ratios being substantially below 1. Thus, they may be considered more reliable in terms of endurance and survival in gameplay compared to others with higher HRs and less significant $p - values$. Moreover, in Table 3, the statistical test results, which consist of the Likelihood Ratio Test with a significant $p - value$ of 0.02, the Wald Test with a significant $p - value\ of\ 0.01$, and the Score (Logrank) Test with a significant $p - value$ of 0.005, provide clear evidence of the better evaluated performance of middle-order batsmen. Similarly, the results obtained in Table 2 are plotted in Figure 8, providing a clearer interpretation of the results.

Table 4: Cox-PH Model Results Using BF as Time Variable

Player	**Coef**	**exp (Coef)**	**exp (-Coef)**	**se (Coef)**	**Lower 0.95**	**Upper 0.95**	z	$p\ (>\|z\|)$
Azam Khan	0.421	1.524	0.655	0.392	0.706	3.291	1.07	0.28267
Faheem Ashraf	0.096	1.101	0.907	0.406	0.497	2.442	0.23	0.81136
Fakhar Zaman	-0.901	0.406	2.463	0.330	0.212	0.775	-2.73	**0.00633****
Haider Ali	-0.474	0.622	1.607	0.346	0.315	1.227	-1.36	0.17116
Iftikhar Ahmed	-0.879	0.414	2.410	0.287	0.236	0.728	-3.06	**0.00218****
Imad Wasim	-0.865	0.421	2.374	0.367	0.204	0.865	-2.35	**0.01871***
Khushdil Shah	-1.007	0.365	2.737	0.349	0.184	0.724	-2.88	**0.00395***
M. Nawaz	-0.686	0.503	1.985	0.331	0.262	0.964	-2.06	**0.03862***
Shadab Khan	-0.615	0.540	1.850	0.307	0.296	0.964	-2.003	**0.04522***
Shan Masood	-1.526	0.217	4.603	0.558	0.072	0.648	-2.73	**0.00625****
Shoaib Malik	-1.507	0.221	4.517	0.559	0.073	0.663	-2.69	**0.00708****

Table 5: Statistical Test Results

Test	Results
Concordance	**0.626** (Standard Error = 0.023)
Likelihood Ratio Test	**30.27** on 11 df, **p = 0.001**
Wald Test	**32.48** on 11 df, **p = 0.006**
Score (Log rank) Test	**35.4** on 11 df, **p = 0.0002**

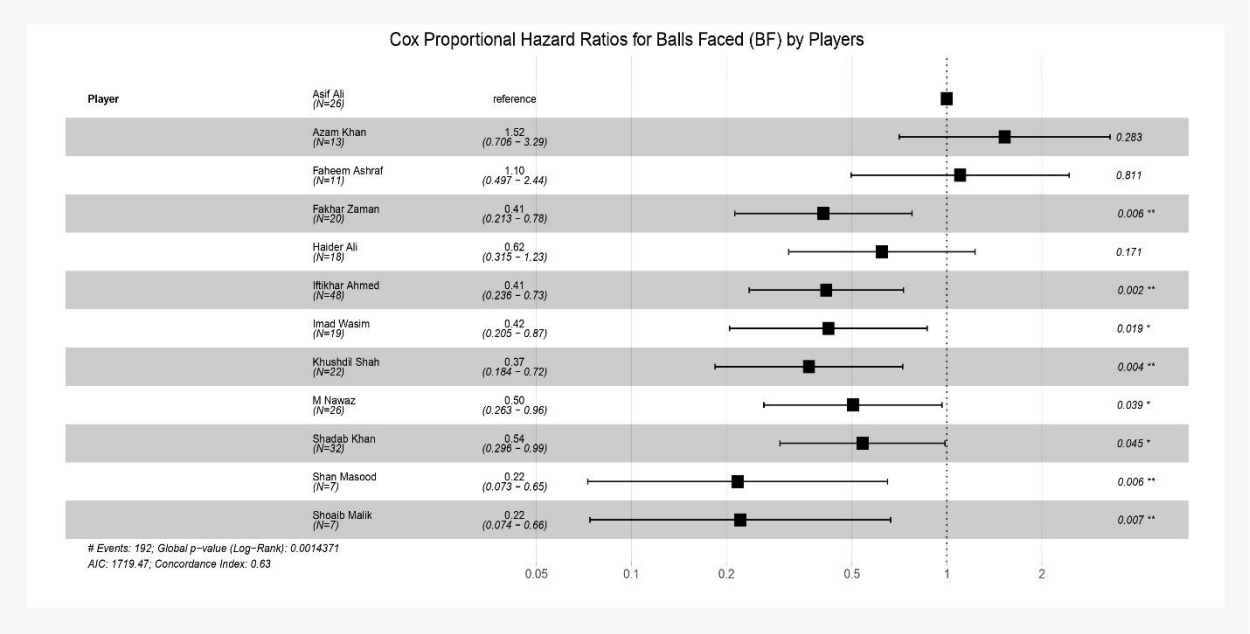

Figure 9: Cox-PH Model, Hazard Ratios Assessing Players' Balls Faced

The above results and the corresponding plot are obtained using Balls Faced (BF) as the time variable in the Cox-PH model. In Table 4, the model outputs for each player include estimated coefficients, hazard ratios (exp (Coef)), 95% confidence intervals, $z - statistics$, and corresponding $p - values$ $(Pr(> |z|))$, offering a comprehensive comparison of their performance. Based on these results, the hazard ratios for Iftikhar Ahmed $(HR = 0.41)$, Fakhar Zaman $(HR = 0.41)$, Shan Masood $(HR = 0.22)$, and Shoaib Malik $(HR = 0.22)$ are notably below 1 and statistically significant $(p < 0.01)$. This suggests that these players are associated with a considerably lower hazard of dismissal per ball faced, implying better ability to survive longer at the crease an especially valuable trait for middle-order batting in T20 internationals. The performances of Khushdil Shah $(HR = 0.37)$, Imad Wasim $(HR = 0.42)$, M. Nawaz $(HR = 0.50)$, and Shadab Khan $(HR = 0.54)$ are also statistically significant $(p < 0.05)$, indicating a moderately strong effect on survival time, though not as substantial as those with lower HRs.

In contrast, the remaining players, such as Azam Khan and Faheem Ashraf, exhibit nonsignificant $p - values$ and HRs above 1, suggesting less consistency in staying at the crease for extended periods. Overall, hazard ratios along with their confidence intervals provide an interpretable measure of relative risk, reinforcing the conclusion that players with significantly lower HRs contribute more effectively to the team's batting stability. Additionally, the statistical test results in Table 5 show that all the $p - values$ are much smaller than 0.05 for the Likelihood Ratio Test, Wald Test, and Log rank Test. These significant results clearly indicate the evaluated performance of the players. Moreover, Figure 9 is plotted based on the results of Table 4 for clearer interpretation.

2.3 The Log Rank Test:

The log-rank test is a useful statistical test for comparing the survival distribution of two or more groups. For example, in health, one can compare the effectiveness of two treatments on patient survival, or in cricket, compare the performance of two groups where the event can be considered as getting out (i.e., losing the wicket). By using the log-rank test, we can also check whether there is any significant difference among the groups. The log-rank test statistic is approximately distributed as $\chi 2$ (Chi-Square), with the formula as:

$$\chi^2 = \left(\frac{O_i - E_i}{V_i}\right)^2$$

Where,

O_i is the observed number of events ith Group

E_i is the expected number of events for ith Group

V_i is the variance for ith Group

In the present study, we divided all players into two groups based on two performance aspects. Firstly, we calculated the average runs of each player and categorized them into two groups: Group I consist of players with average runs greater than 15 (> 15), and Group II includes players with average runs less than or equal to

15 ($\leq$ 15). The threshold of 15 runs was selected considering the high-risk nature of T20 cricket, where players have opportunity to face limited balls due to the short format. Scoring more than 15 runs per innings is considered a valuable contribution under such constraints, especially for middle-order batsmen.
Secondly, we categorized players based on their average strike rate (SR). Group I include those with an average SR of 130 or higher ($\geq$ 130), while Group II includes those with an average SR below 130 ($<$ 130). A strike rate above 130 is a commonly accepted benchmark in T20 cricket, as it reflects the player's ability to score quickly an essential factor in finishing games in pressure situations.

These groupings help in identifying players who can balance both survival and scoring under pressure. For team selection and batting order decisions, players falling in Group I for both criteria (i.e., average runs $>$ 15 and average $SR \geq 130$) may be preferred for key middle-order or finisher roles. Such players are likely to contribute consistently and can adapt to the aggressive demands of T20 formats.
Below are the results and corresponding plots for both aspects of the study. To enhance clarity, we have improved the readability of the figures and added brief discussions alongside each to better interpret their practical implications.

Table 6: Log-Rank Test Results for High and Low Average Runs Groups

Group	**N**	**Observed**	**Expected**	$\frac{(O-E)^2}{E}$	$\frac{(O-E)^2}{V}$
High Av Runs	108	84	100.8	2.81	6.3
Low Av Runs	141	108	91.2	3.11	6.3
	$\chi^2 = 6.3$ on 1 degree of freedom (df)				$p = 0.01$

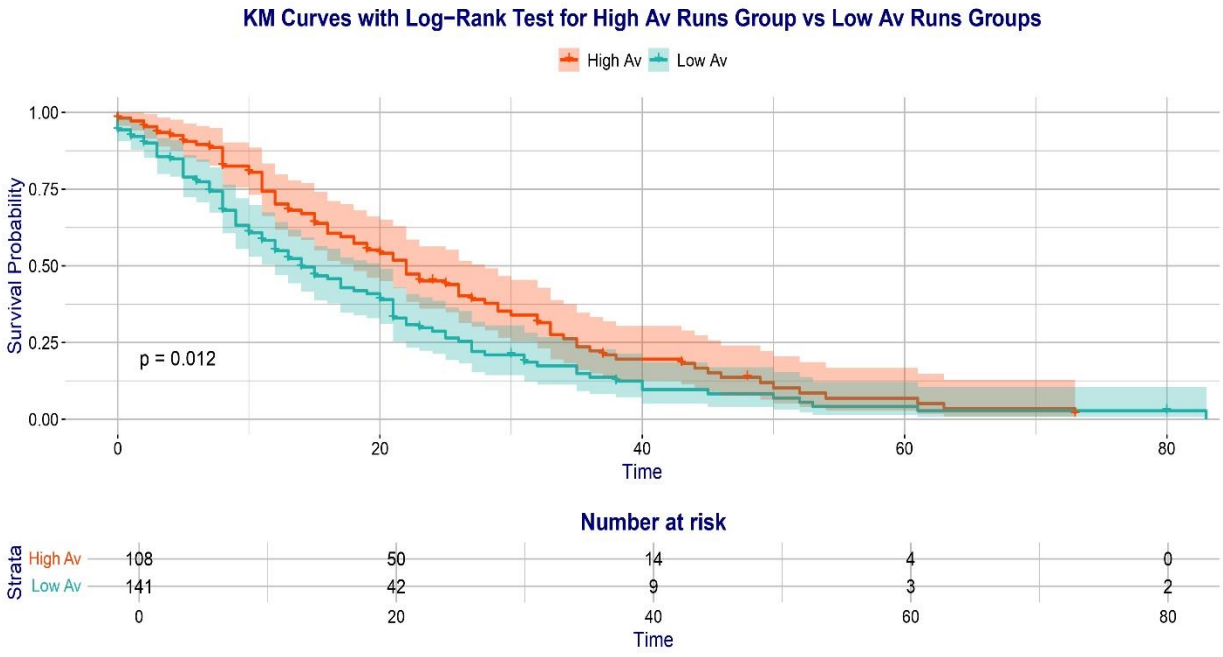

Figure 10: Log Rank Curves for Both Group Using Average Runs of Players

In Table 6, we obtained the results using the log-rank test for high and low average runs to compare the performance of both groups. The χ^2 (Chi-Square) value is 6.3 on 1 df with a $p - value\ of$ 0.01, suggesting a statistically significant difference in survival rates between the high and low average runs groups. The high average runs group consists of fewer observed events than expected, while the low average runs group has more

observed events than expected. Hence, these results indicate that the higher average runs group possesses greater potential to survive and perform better compared to the low average runs group. Moreover, in Figure 10, the survival curves of both groups are plotted according to the obtained results. The survival curve of the higher average runs group is better than that of the low average runs group.

Table 7: Log-Rank Test Results for High and Low Average Strike Rate Groups

Group	**N**	**Observed**	**Expected**	$\frac{(O-E)^2}{E}$	$\frac{(O-E)^2}{V}$
High Av Runs	46	38	43.3	0.638	0.866
Low Av Runs	203	154	148.7	0.185	0.866
	$\chi^2 = 0.9$ on 1 degree of freedom (df)				$p = 0.35$

Using the Log-Rank Test results obtained in Table 7, players were divided into two groups based on their average strike rate: High and Low Average SR groups. The High Av SR group had more expected events than observed, while the Low Av SR group had fewer expected events than observed, where Av is stand for Average. Moreover, the χ^2 (Chi-Square) value is 0.9 on 1 degree of freedom, with a non-significant $p - value = 0.35$, clearly indicates that there is no statistically significant difference in the survival rates of the two groups. In other words, there is no strong evidence to suggest a difference in survival outcomes between the two groups. Moreover, Figure 11 presents the survival curves for both groups based on the derived results.

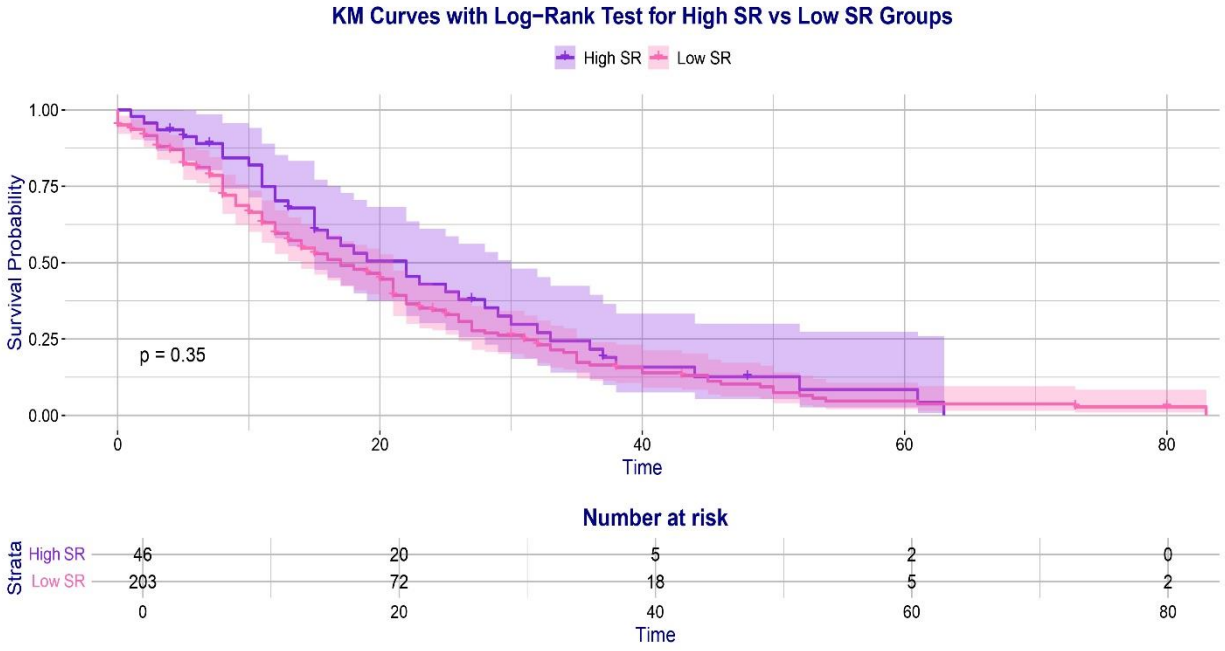

Figure 11: Log Rank Curves for Both Group Using Average SR of Players

Contrasting Log-Rank Test Findings; Average Runs and Strike Rate:

In an earlier interpretation, we explained the results and significance for both the Average Runs Groups and the Average SR Groups. Here, the main objective is to compare the performance of these groups based on both aspects, i.e. average runs and average strike rate. The obtained results in Table 6, with a significant $p - value$, suggest that based on average runs, the High Average Runs Group is performing well. In contrast, the Low

Average Runs Group needs to improve their average runs to contribute more to Team Pakistan's success in winning matches.
In Table 7, the non-significant $p - value$ indicates that there is no difference between the two groups based on average strike rate. However, the Low Av SR Group had more observed events than expected, which is not better compared to the High Av SR Group.
In summary, the average runs performance of the High Av Runs Group is clearly far better than that of the Low Av Runs Group. While the average strike rate performance, with a nonsignificant $p - value$, indicates no difference, if we look at the expected events of these two groups, the High Av SR Group is better, and the Low Av SR Group needs to improve their performance.

3. Discussion and Conclusion

The primary goal of this study was to assess the success of Team Pakistan's middle-order batsmen in T20 Internationals. In recent years, Pakistan has lost many matches due to the frequent collapse of its middle-order batting. To address this issue, the Pakistan Cricket Board (PCB) and its selection committee tried various batsmen in the middle-order positions. To investigate the performance of these batsmen in T20 Internationals, we collected data from the past four years from ESPNcricinfo. In this study, we applied survival analysis approaches, considering variables such as innings played, runs scored, strike rate (SR), balls faced (BF), minutes at the crease (Mins), average runs, and average strike rate.

Initially, the Kaplan-Meier (KM) method was employed to analyze KM curves in relation to runs scored, strike rate, and survival at the crease for the next delivery. Based on the KM curves, we concluded that Fakhar Zaman, Shoaib Malik, Shadab Khan, and Haider Ali performed well, by scoring runs with a good strike rate. Although Asif Ali and Iftikhar Ahmed have impressive strike rates, they struggle to score more runs and stay at the crease for longer periods. Additionally, Imad Wasim, Fakhar Zaman, Shoaib Malik, Haider Ali, and Shan Masood have a high ability to face the next ball without losing their wicket. Subsequently, we applied the Cox Proportional Hazards Model, using minutes at the crease (Mins) and balls faced (BF) as time variables to examine the impact of covariates on survival. Based on the results, we inferred that Iftikhar Ahmed and Shan Masood are more likely to spend extended time at the crease. Furthermore, the derived results suggest that Fakhar Zaman, Iftikhar Ahmed, Shoaib Malik, and Shan Masood have the potential to face a greater number of deliveries. Moreover, the Log-Rank test was conducted to compare the survival distributions of two groups, divided based on two aspects: high and low average runs (High Av Runs and Low Av Runs) and high and low average strike rates (High Av SR and Low Av SR). The results showed a significant difference ($p - value = 0.01$) between the two groups when comparing their average runs. However, when considering the average strike rate, there was no significant difference ($p - value = 0.35$) between the groups.

From the analysis of this study, we infer that the performances of Fakhar Zaman, Iftikhar Ahmed, Shoaib Malik, and Haider Ali are far better than those of other players. Additionally, Imad Wasim and Shadab Khan can also play well, based on the results of the KM and Cox Proportional Hazards models. However, the performance of the remaining players is unsatisfactory in terms of their contribution to winning matches for Team Pakistan in T20 international cricket.

These findings provide practical insights that can inform evidence-based decision-making by the PCB and coaching staff. Specifically, players like Iftikhar Ahmed and Shan Masood, who demonstrate longer survival at the crease, and those like Fakhar Zaman and Shoaib Malik, who combine resilience with scoring ability, should be prioritized for key middle-order positions. Batting order decisions and lineup selection should emphasize not just strike rate but the capacity to stay at the crease under pressure. Incorporating such data-driven strategies could significantly enhance Pakistan's middle-order stability and overall match outcomes. Future studies may consider extending this analysis to opponent-specific or match-condition-specific performance to further refine team composition.

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