|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Summary Literature** | | | | | | | | |
|  | Covid-19 Natural Experiment | Country aggregate | Crowd Occupancy | Referee Bias | Crowd size | Team Age | Share of Foreigners | Study Conclusions |
| Boyko, Boyko, & Boyko (2007) | 🗶 | 🗶 | ✓ | ✓ | ✓ | 🗶 | 🗶 | Indivdual referees give significant different responses to crowd noise and have significant different levels of home team bias. |
| Carron & Agnew (1994) | 🗶 | 🗶 | ✓ | ✓ | ✓ | 🗶 | 🗶 | There is a positive relationship with crowd density and home advantage. But the explanatory power of crowd support effects is rather low |
| Courneya & Carron (1992) | 🗶 | ✓ | 🗶 | 🗶 | ✓ | 🗶 | 🗶 | Crowd size is a significant predictor of home advantage |
| Endrich& Gesche (2020) | ✓ | 🗶 | ✓ | ✓ | 🗶 | 🗶 | 🗶 | There is a significant change in punishment for away teams in the situation of “ghost games”. |
| Fischer & Haucap (2020) | ✓ | 🗶 | ✓ | ✓ | ✓ | 🗶 | 🗶 | Crowd occupancy is the main driver of differences in home advantage pre and post covid-19. Referee bias and absolute crowd size appear less important. |
| Mccarick et al(2020) | ✓ | ✓ | ✓ | ✓ | 🗶 | 🗶 | 🗶 | Home advantage decreased significantly after covid-19, points and goals for home teams decreased. Also referee issued significantly fewer sanctions against away teams. |
| Nevill & Holder  (1999) | 🗶 | 🗶 | 🗶 | ✓ | ✓ | 🗶 | 🗶 | Referee bias is the most important component of crowd support effect on team performance |
| Pollard (2006) | 🗶 | ✓ | 🗶 | ✓ | ✓ | 🗶 | 🗶 | Home advantage is a result of many different factors all interacting with each-other. With differeng levels across countries and sports. |
| Pollard (2008) | 🗶 | ✓ | 🗶 | ✓ | ✓ | 🗶 | 🗶 | Home advantage is a result of many different factors all interacting with each-other. |
| Ponzo & Scoppa (2018) | 🗶 | 🗶 | 🗶 | ✓ | 🗶 | 🗶 | 🗶 | Home advantage still persists in derby matches, where familiarity and travel factors are mitigated. Supporting the notion of crowd support influencing home advantage. |
| Schwartz & Barsky (1977) | 🗶 | ✓ | ✓ | 🗶 | ✓ | 🗶 | 🗶 | Home advantage primarily sterns from crowd support. With stronger crowd support(occupancy/size) increasing home advantage |
| Van der Ven (2016) | 🗶 | 🗶 | 🗶 | 🗶 | 🗶 | ✓ | 🗶 | Teams with a higher average age perform better in Away games |
| Tilp & Thaller (2020) | ✓ | 🗶 | 🗶 | ✓ | 🗶 | 🗶 | 🗶 | Covid has turned home advantage into a home disadvantage in case of “ghost games” |
| THIS PAPER | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Summary Statistics** | | | | | | | | |
|  | **Mean** | **SD** | **Min** | **Pctl(25)** | **Median** | **Pctl(75)** | **Max** | **N** |
| **Dependent variables** | | | | | | | | |
| Goal Difference | 0.292 | 1.846 | -13.00 | -1.00 | 0.00 | -1.00 | 10.00 | 8,137 |
| Points Difference | 0.365 | 2.571 | -3.00 | -3.00 | 0 | 3 | 3 | 8,137 |
| **Moderators** | | | | | | | | |
| Foreigners Share Difference | 0.001 | 0.213 | -0.752 | -0.139 | -0.001 | 0.139 | 0.752 | 8,137 |
| Age Difference | 0.001 | 1.573 | -5.00 | -1.100 | 0.00 | 1.10 | 5.00 | 8,137 |
| Occupancy Rate | 0.713 | 0.227 | 0.00 | 0.558 | 0.763 | 0.911 | 1 | 8,137 |
| Crowd Size(1000’s) | 24.18 | 18.03 | 0.00 | 10.51 | 19.23 | 35.19 | 81.17 | 8,137 |
| **Mediators** | | | | | | | | |
| Foul Difference | 0.108 | 5.243 | -18.00 | -3.00 | 0.00 | 4.00 | 24.00 | 8,137 |
| Yellow Card Difference | 0.185 | 1.747 | -7.00 | -1.0 | 0.00 | 1.00 | 7.00 | 8,137 |
| Red Card Difference | 0.026 | 0.456 | -3.00 | 0.00 | 0.00 | 0.00 | 3.00 | 8,137 |
| **Control Variables** | | | | | | | | |
| Rating Difference | 0.101 | 15.63 | -58.31 | -9.64 | 0.24 | 9.80 | 62.27 | 8,137 |
| Importance Difference | 1.095 | 32.10 | -100 | -16.78 | 0.10 | 19.48 | 100 | 8,054 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Summary Statistics** | | | | | | | | |
| **Dependent variables** | **Mean** | **SD** | **Min** | **Pctl(25)** | **Median** | **Pctl(75)** | **Max** | **N** |
| Goal Difference | 0.292 | 1.846 | -13.00 | -1.00 | 0.00 | -1.00 | 10.00 | 8,137 |
| Points Difference | 0.365 | 2.571 | -3.00 | -3.00 | 0.00 | 3.00 | 3.00 | 8,137 |
| **Moderators** | | | | | | | | |
| Foreigners Share Difference | 0.001 | 0.213 | -0.752 | -0.139 | -0.001 | 0.139 | 0.752 | 8,137 |
| Age Difference | 0.001 | 1.573 | -5.00 | -1.100 | 0.000 | 1.10 | 5.00 | 8,137 |
| Occupancy Rate | 0.713 | 0.227 | 0.00 | 0.558 | 0.763 | 0.911 | 1.00 | 8,137 |
| Crowd Size(1000’s) | 24.18 | 18.03 | 0.00 | 10.51 | 19.23 | 35.19 | 81.17 | 8,137 |
| **Mediators** | | | | | | | | |
| Foul Difference | 0.108 | 5.243 | -18.00 | -3.00 | 0.00 | 4.00 | 24.00 | 8,137 |
| Yellow Card Difference | 0.185 | 1.747 | -7.00 | -1.0 | 0.00 | 1.00 | 7.00 | 8,137 |
| Red Card Difference | 0.026 | 0.456 | -3.00 | 0.00 | 0.00 | 0.00 | 3.00 | 8,137 |
| **Control Variables** | | | | | | | | |
| Rating Difference | 0.101 | 15.63 | -58.31 | -9.64 | 0.24 | 9.80 | 62.27 | 8,137 |
| Importance Difference | 1.095 | 32.10 | -100 | -16.78 | 0.10 | 19.48 | 100 | 8,054 |

|  |  |  |
| --- | --- | --- |
| **Variable operationalization table** | | |
| Variable | Operationalization | Source |
| **Dependent variables** |  |  |
| Points difference | Number of points home team minus number of points away team | Football-data.co.uk |
| Goal difference | Number of goals home team minus number of goals away team | Football-data.co.uk |
| **Moderators** | | |
| Foreigner share difference | Share of playing time for foreigners in home team minus share of playing time for foreigners in away team | Transfermarkt.com |
| Age difference | Average age home team minus average age away team | Transfermarkt.com |
| Occupancy rate | Average crowd size/Stadium capacity | Transfermarkt.com |
| Crowd size | Average crowd size/1000 | Transfermarkt.com |
| **Mediators** | | |
| Yellow card difference | Number of yellow cards away team minus number of yellow cards home team | Football-data.co.uk |
| Foul difference | Number of fouls away team minus number of fouls home team | Football-data.co.uk |
| Red card difference | Number of red cards away team minus number of red cards home team | Football-data.co.uk |
| **Independent variables** | | |
| Covid | 1 = post-covid 0 = pre covid |  |
| **Control variables** | | |
| Rating difference | Home team SPI rating minus away team SPI rating | Projects.fivethirtyeight.com |
| Importance difference | Home team match importance minus away team match importance | Projects.fivethirtyeight.com |
| VAR | 1 if VAR technology available 0 if not | Projects.fivethirtyeight.com |
| Shots Difference | Number of shots home team minus number of shots away team | Football-data.co.uk |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Comparison pre and post covid** | | | | |
|  | **Pre-Covid** | **Post-Covid** | **Statistic** | **P-value** |
| Goal Difference | .36 | .17 | .5300 | *p* < .001 \* \* \* |
| Expected goals difference | .31 | .16 | .5364 | *p* < .001 \* \* \* |
| Yellow Card Difference | .30 | -.01 | .5518 | *p* < .001 \* \* \* |
| Red Card Difference | .03 | .01 | .5113 | *p* < .001 \* \* \* |
| Foul Difference | .29 | -.21 | .5258 | *p* < .001 \* \* \* |
| Points Difference | .46 | .20 | .5282 | *p* < .001 \* \* \* |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Home and away statistics comparison** | | | | |
|  | **Pre-Covid** | **Post-Covid** | **Test Statistic** | **P value** |
| Percentage points Home | .58 | .53 | .5282 | *p* < .001 \* \* \* |
| Points Home | 1.61 | 1.47 | .5282 | *p* < .001 \* \* \* |
| Home Goals | 1.58 | 1.47 | .5244 | *p* < .001 \* \* \* |
| Percentage home Wins | .45 | .40 | 74.252^ | *p* < .001 \* \* \* |
| Expected goals Home | 1.57 | 1.46 | .5406 | *p* < .001 \* \* \* |
| Home Shots | 13.34 | 12.26 | .5605 | *p* < .001 \* \* \* |
| Home Shots on Target | 5.06 | 4.63 | .5462 | *p* <. 001 \* \* \* |
| Percentage points Away | .42 | .47 | .4718 | *p*  < .001 \* \* \* |
| Points Away | 1.15 | 1.27 | .4718 | *p*  < .001 \* \* \* |
| Away Goals | 1.22 | 1.30 | .4791 | *p*  < .001 \* \* \* |
| Percentage Away wins | .30 | .34 | 74.252^ | *p* < .001 \* \* \* |
| Expected goals Away | 1.25 | 1.30 | .4846 | *p*  = .043\* |
| Away Shots | 10.78 | 10.92 | .4918 | *p* = .2156 |
| Away Shots on Target | 4.10 | 4.10 | .5016 | *p* = .8079 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Referee statistics** | | | | |
|  | **Pre-Covid** | **Post-Covid** | **Test Statistic** | **P value** |
| Yellow Card Home | 1.96 | 2.00 | .4915 | *p* = .1898 | |
| Red Card Home | .09 | .10 | .4977 | *p* = .4763 | |
| Fouls Home | 12.87 | 13.14 | .4802 | *p* = .003\* \* | |
| Yellow Card Away | 2.26 | 1.98 | .5542 | *p* < .001 \* \* \* | |
| Red Card Away | .13 | .11 | .5098 | *p* < .001 \* \* \* | |
| Fouls Away | 13.17 | 12.93 | .5128 | *p* = .053 | |

Cronbach’s Alpha

|  |  |  |  |
| --- | --- | --- | --- |
| **Cronbach’s Alpha for Referee Bias latent construct** | | | |
|  | **Alpha** | **Good fit** | **Pass test** |
| Yellow Cards + Fouls + Red Cards | .25 | >.70 | No |
| Yellow Cards + Fouls | .32 | >.70 | No |

Goal:

|  |  |  |  |
| --- | --- | --- | --- |
| **Fit indices** | | | |
|  | **Actual fit** | **Good fit** | **Pass test** |
| Chi-square | .000 | >.05 | No |
| RMSEA | .030 | < .05 | Yes |
| SRMR | .010 | < .05 | Yes |
| CFI | .963 | > .90 | Yes |
| TLI | .902 | > .95 | No |

Point:

|  |  |  |  |
| --- | --- | --- | --- |
| **Fit indices** | | | |
|  | **Actual fit** | **Good fit** | **Pass test** |
| Chi-square | .000 | >,05 | No |
| RMSEA | .027 | <.05 | Yes |
| SRMR | .010 | <.05 | Yes |
| CFI | .966 | >.90 | Yes |
| TLI | .911 | >.95 | No |

Point with red card:

|  |  |  |  |
| --- | --- | --- | --- |
| **Fit indices** | | | |
|  | **Actual fit** | **Good fit** | **Pass test** |
| Chi-square | .000 | >,05 | No |
| RMSEA | .048 | <.05 | Yes |
| SRMR | .020 | <.05 | Yes |
| CFI | .834 | >.90 | No |
| TLI | .689 | >.95 | No |

Point only yellow card

|  |  |  |  |
| --- | --- | --- | --- |
| **Fit indices** | | | |
|  | **Actual fit** | **Good fit** | **Pass test** |
| Chi-square | .000 | >,05 | No |
| RMSEA | .031 | <.05 | Yes |
| SRMR | .005 | <.05 | Yes |
| CFI | .987 | >.90 | Yes |
| TLI | .880 | >.95 | No |

Goal only yellow card

|  |  |  |  |
| --- | --- | --- | --- |
| **Fit indices** | | | |
|  | **Actual fit** | **Good fit** | **Pass test** |
| Chi-square | .000 | >,05 | No |
| RMSEA | .037 | <.05 | Yes |
| SRMR | .005 | <.05 | Yes |
| CFI | .985 | >.90 | Yes |
| TLI | .865 | >.95 | No |

|  |  |  |  |
| --- | --- | --- | --- |
| **Hypotheses overview** | | | |
|  | Hypothesis | Accept | Findings |
| Hypothesis 1 | Crowd support positively influences Home Team Performance. | ✓ | The points gap decreased by .285 and the goals gap decreased by .202 because of the absent crowd support. |
| Hypothesis 2 | The effect of crowd support on team performance is mediated by referee bias | ✓ | The effect of crowd support on team performance is mediated by referee bias, with a 1 unit increase in referee bias decreasing points gap by .019 |
| Hypothesis 3a | The effect of crowd support on team performance increases when crowd size increases. | 🗶 | Crowd size does not significantly alter the influence of crowd support on team performance (*β* =.042 , *p* =.528 ) |
| Hypothesis 3b | The mediating effect of referee bias on the relationship between crowd support and team performance increases when crowd size increases. | 🗶 | Crowd size does not significantly alter the influence of crowd support on referee bias  (*β* =-.001 , *p* = .752 ) |
| Hypothesis 4a | The effect of crowd support on team performance increases when stadium occupancy increases. | ✓ | The points gap without crowd support is .482 lower and the goals gap is .359 lower for teams with high occupancy levels compared to teams with low occupancy levels |
| Hypothesis 4b | The mediating effect of referee bias on the relationship between crowd support and team performance increases when stadium occupancy increases | 🗶 | The occupancy rate does not significantly alter the influence of crowd support on referee bias (*β* = .001 , *p* = .714) |
| Hypothesis 5a | The effect of crowd support on team performance is weakened when the share of foreigners increases. | 🗶 | The amount of playing time for foreigners does not significantly alter the influence of crowd support on team performance  *(β*= -011, p = .852) |
| Hypothesis 5b | The mediating effect of referee bias on the relationship between crowd support and team performance decreases when the share of foreigners increases. | 🗶 | The amount of playing time for foreigners does not significantly alter the influence of crowd support on referee bias(*β* =-.001 ,  *p* = .789) |
| Hypothesis 6 | The positive effect of crowd support on home team performance relative to away team performance decreases with away team’s age relative to home team’s age. | 🗶 | Player age does not significantly alter the influence of crowd support on team performance (*β* = -.074, *p* = .179) |

|  |  |  |
| --- | --- | --- |
| **Differences for Occupancy** | | |
|  | **Points Difference** | **Goal Difference** |
| Total effect Low Occupancy | -.087  (.087) | -.045  (.058) |
| Total effect mean Occupancy | **-.285\*\*\***  **(.056)** | **-.202\*\*\***  **(.030)** |
| Total Effect High Occupancy | **-.482\*\*\***  **(.090)** | **-.359\*\*\***  **(.063)** |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Summary Statistics total sample** | | | | | | | | |
|  | **N** | **Mean** | **SD** | **Min** | **Pctl(25)** | **Median** | **Pctl(75)** | **Max** |
| Goal Difference | 8,137 | 0.292 | 1.846 | -13 | -1 | 0 | -1 | 10 |
| Points Difference | 8,137 | 0.365 | 2.571 | -3 | -3 | 0 | 3 | 3 |
| Foreigners Share Difference | 8,137 | 0.001 | 0.213 | -0.752 | -0.139 | -0.001 | 0.139 | 0.752 |
| Age Difference | 8,137 | 0.001 | 1.573 | -5 | -1.100 | 0 | 1.10 | 5 |
| Occupancy Rate | 8,137 | 0.713 | 0.227 | 0 | 0.558 | 0.763 | 0.911 | 1 |
| Crowd Size(1000’s) | 8,137 | 24.18 | 18.03 | 0 | 10.51 | 19.23 | 35.19 | 81.17 |
| Foul Difference | 8,137 | 0.108 | 5.243 | -18 | -3 | 0 | 4 | 24 |
| Yellow Card Difference | 8,137 | 0.185 | 1.747 | -7 | -1 | 0 | 1 | 7 |
| Red Card Difference | 8,137 | 0.026 | 0.456 | -3 | 0 | 0 | 0 | 3 |
| Rating Difference | 8,137 | 0.101 | 15.63 | -58.31 | -9.64 | 0.24 | 9.80 | 62.27 |
| Importance Difference | 8,054 | 1.095 | 32.10 | -100 | -16.78 | 0.10 | 19.48 | 100 |
| Home goals | 8,137 | 1.542 | 1.303 | 0 | 1 | 1 | 2 | 10 |
| Away goals | 8,137 | 1.250 | 1.179 | 0 | 0 | 1 | 2 | 13 |
| Home shots | 8,137 | 12.946 | 5.165 | 0 | 9 | 12 | 16 | 38 |
| Away shots | 8,137 | 10.835 | 4.668 | 0 | 7 | 10 | 14 | 45 |
| Home shots on target | 8,137 | 4.899 | 2.640 | 0 | 3 | 5 | 6 | 18 |
| Away shots on target | 8,137 | 4.097 | 2.398 | 0 | 2 | 4 | 6 | 23 |
| Home fouls | 8,137 | 12.970 | 4.184 | 0 | 10 | 13 | 16 | 31 |
| Away fouls | 8,137 | 13.078 | 4.277 | 0 | 10 | 13 | 16 | 34 |
| Home corners | 8,137 | 5.405 | 2.972 | 0 | 3 | 5 | 7 | 23 |
| Away corners | 8,137 | 4.526 | 2.650 | 0 | 3 | 4 | 6 | 17 |
| Home yellow cards | 8,137 | 1.974 | 1.393 | 0 | 1 | 2 | 3 | 8 |
| Away yellow cards | 8,137 | 2.159 | 1.414 | 0 | 1 | 2 | 3 | 8 |
| Home red cards | 8,137 | 0.094 | 0.314 | 0 | 0 | 0 | 0 | 3 |
| Away red cards | 8,137 | 0.120 | 0.351 | 0 | 0 | 0 | 0 | 3 |
| Average age home team | 8,137 | 26.244 | 1.457 | 22 | 25.3 | 26.3 | 27.2 | 30 |
| Share of foreigners home team | 8,137 | 0.570 | 0.175 | 0.010 | 0.452 | 0.595 | 0.701 | 0.940 |
| Average age away team | 8,137 | 26.244 | 1.458 | 22.500 | 25.300 | 26.300 | 27.200 | 30.400 |
| Share of foreigners away team | 8,137 | 0.570 | 0.175 | 0.010 | 0.452 | 0.595 | 0.702 | 0.940 |
| Spi rating home team | 8,137 | 60.012 | 16.006 | 21.450 | 47.000 | 61.270 | 71.430 | 95.750 |
| Spi rating away team | 8,137 | 59.912 | 15.994 | 21.150 | 46.780 | 61.110 | 71.250 | 95.470 |
| Importance rating home team | 8,054 | 33.614 | 24.951 | 0.000 | 13.325 | 30.800 | 48.900 | 100.000 |
| Importance rating away team | 8,054 | 32.519 | 24.641 | 0.000 | 12.600 | 29.200 | 48.000 | 100.000 |
| Expected goals home team | 5,999 | 1.528 | 0.884 | 0.000 | 0.875 | 1.380 | 2.020 | 7.070 |
| Expected goals away team | 5,999 | 1.272 | 0.803 | 0.000 | 0.670 | 1.130 | 1.720 | 8.270 |
| Expected goals difference | 5,999 | 0.256 | 1.299 | -8.040 | -0.560 | 0.240 | 1.060 | 6.790 |
| Home win percentage | 8,137 | 0.436 | 0.496 | 0 | 0 | 0 | 1 | 1 |
| Away wain percentage | 8,137 | 0.314 | 0.464 | 0 | 0 | 0 | 1 | 1 |
| Draw percentage | 8,137 | 0.251 | 0.433 | 0 | 0 | 0 | 1 | 1 |
| Points home team | 8,137 | 1.557 | 1.321 | 0 | 0 | 1 | 3 | 3 |
| Points away team | 8,137 | 1.192 | 1.286 | 0 | 0 | 1 | 3 | 3 |
| Percentage of points home | 8,137 | 0.561 | 0.429 | 0 | 0 | 0.5 | 1 | 1 |
| Percentage of points away | 8,137 | 0.439 | 0.429 | 0 | 0 | 0.5 | 1 | 1 |
| Corner difference | 8,137 | 0.879 | 4.465 | -16 | -2 | 1 | 4 | 20 |
| Shots difference | 8,137 | 8.420 | 6.494 | -14 | 4 | 8 | 12 | 36 |
| Shots on target difference | 8,137 | 0.802 | 3.793 | -23 | -2 | 1 | 3 | 17 |
| Percentage of points difference | 8,137 | 0.122 | 0.857 | -1 | -1 | 0 | 1 | 1 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Summary Statistics covid matches** | | | | | | | | |
|  | **N** | **Mean** | **SD** | **Min** | **Pctl(25)** | **Median** | **Pctl(75)** | **Max** |
| Home goals | 2,996 | 1.469 | 1.269 | 0 | 1 | 1 | 2 | 9 |
| Away goals | 2,996 | 1.299 | 1.185 | 0 | 0 | 1 | 2 | 13 |
| Home shots | 2,996 | 12.262 | 5.002 | 1 | 9 | 12 | 15 | 38 |
| Away shots | 2,996 | 10.924 | 4.743 | 0 | 8 | 10 | 14 | 45 |
| Home shots on target | 2,996 | 4.627 | 2.572 | 0 | 3 | 4 | 6 | 16 |
| Away shots on target | 2,996 | 4.098 | 2.419 | 0 | 2 | 4 | 5.2 | 23 |
| Home fouls | 2,996 | 13.137 | 4.087 | 0 | 10 | 13 | 16 | 31 |
| Away fouls | 2,996 | 12.928 | 4.148 | 0 | 10 | 13 | 16 | 30 |
| Home corners | 2,996 | 5.062 | 2.870 | 0 | 3 | 5 | 7 | 19 |
| Away corners | 2,996 | 4.514 | 2.690 | 0 | 3 | 4 | 6 | 17 |
| Home yellow cards | 2,996 | 1.996 | 1.380 | 0 | 1 | 2 | 3 | 8 |
| Away yellow cards | 2,996 | 1.983 | 1.363 | 0 | 1 | 2 | 3 | 8 |
| Home red cards | 2,996 | 0.097 | 0.316 | 0 | 0 | 0 | 0 | 3 |
| Away red cards | 2,996 | 0.108 | 0.339 | 0 | 0 | 0 | 0 | 3 |
| Average age home | 2,996 | 26.319 | 1.460 | 22.700 | 25.400 | 26.300 | 27.200 | 30.300 |
| Foreigners share home | 2,996 | 0.576 | 0.171 | 0.010 | 0.465 | 0.606 | 0.702 | 0.902 |
| Crowd Size | 2,996 | 23.777 | 18.313 | 0.000 | 9.825 | 18.301 | 35.191 | 81.171 |
| Occupancy rate | 2,996 | 0.694 | 0.239 | 0.000 | 0.536 | 0.732 | 0.909 | 1.000 |
| Average age away | 2,996 | 26.316 | 1.465 | 22.700 | 25.400 | 26.300 | 27.200 | 30.300 |
| Foreigners share away | 2,996 | 0.577 | 0.171 | 0.010 | 0.465 | 0.605 | 0.706 | 0.902 |
| Spi rating home | 2,996 | 59.362 | 16.504 | 24.210 | 45.130 | 60.425 | 71.692 | 95.610 |
| Spi rating away | 2,996 | 59.294 | 16.526 | 24.240 | 44.870 | 60.405 | 71.630 | 95.320 |
| Importance rating home | 2,954 | 33.136 | 25.572 | 0.000 | 11.100 | 30.200 | 49.600 | 100.000 |
| Importance rating away | 2,954 | 31.892 | 25.161 | 0.000 | 10.600 | 28.150 | 48.400 | 100.000 |
| Expected goals home | 2,334 | 1.464 | 0.891 | 0.000 | 0.800 | 1.300 | 1.960 | 6.190 |
| Expected goals away | 2,334 | 1.300 | 0.824 | 0.000 | 0.680 | 1.170 | 1.760 | 8.270 |
| Yellow card difference | 2,996 | -0.013 | 1.714 | -6 | -1 | 0 | 1 | 6 |
| Rating difference | 2,996 | 0.069 | 15.561 | -53.260 | -10.233 | 0.330 | 10.060 | 57.420 |
| Expected goals difference | 2,334 | 0.164 | 1.334 | -8.040 | -0.710 | 0.125 | 0.990 | 5.570 |
| Age difference | 2,996 | 0.002 | 1.573 | -4.800 | -1.100 | 0.000 | 1.000 | 4.500 |
| Red card difference | 2,996 | 0.011 | 0.447 | -3 | 0 | 0 | 0 | 3 |
| Importance difference | 2,954 | 1.245 | 32.330 | -100.000 | -16.400 | 0.100 | 20.000 | 100.000 |
| Percentage home wins | 2,996 | 0.404 | 0.491 | 0 | 0 | 0 | 1 | 1 |
| Percentage away wins | 2,996 | 0.338 | 0.473 | 0 | 0 | 0 | 1 | 1 |
| Percentage draws | 2,996 | 0.258 | 0.437 | 0 | 0 | 0 | 1 | 1 |
| Home points | 2,996 | 1.469 | 1.317 | 0 | 0 | 1 | 3 | 3 |
| Away points | 2,996 | 1.273 | 1.298 | 0 | 0 | 1 | 3 | 3 |
| Goal difference | 2,996 | 0.170 | 1.821 | -13 | -1 | 0 | 1 | 9 |
| Points difference | 2,996 | 0.196 | 2.578 | -3 | -3 | 0 | 3 | 3 |
| Foul difference | 2,996 | -0.210 | 5.207 | -18 | -4 | 0 | 3 | 19 |
| Foreigners share difference | 2,996 | -0.001 | 0.210 | -0.752 | -0.139 | -0.001 | 0.135 | 0.717 |
| Percentage points home | 2,996 | 0.533 | 0.430 | 0.000 | 0.000 | 0.500 | 1.000 | 1.000 |
| Percentage points away | 2,996 | 0.467 | 0.430 | 0.000 | 0.000 | 0.500 | 1.000 | 1.000 |
| Corner difference | 2,996 | 0.547 | 4.419 | -16 | -2 | 1 | 3 | 17 |
| Shots difference | 2,996 | 7.748 | 6.375 | -13 | 3 | 8 | 12 | 36 |
| Shots on target difference | 2,996 | 0.529 | 3.760 | -23 | -2 | 1 | 3 | 15 |
| Percentage points difference | 2,996 | 0.065 | 0.859 | -1 | -1 | 0 | 1 | 1 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Summary Statistics pre-covid matches** | | | | | | | | |
|  | **N** | **Mean** | **SD** | **Min** | **Pctl(25)** | **Median** | **Pctl(75)** | **Max** |
| Home goals | 5,141 | 1.584 | 1.321 | 0 | 1 | 1 | 2 | 10 |
| Away goals | 5,141 | 1.222 | 1.176 | 0 | 0 | 1 | 2 | 9 |
| Home shots | 5,141 | 13.344 | 5.217 | 0 | 10 | 13 | 16 | 38 |
| Away shots | 5,141 | 10.783 | 4.623 | 0 | 7 | 10 | 14 | 34 |
| Home shots on target | 5,141 | 5.058 | 2.666 | 0 | 3 | 5 | 7 | 18 |
| Away shots on target | 5,141 | 4.096 | 2.386 | 0 | 2 | 4 | 6 | 22 |
| Home fouls | 5,141 | 12.873 | 4.237 | 0 | 10 | 13 | 16 | 31 |
| Away fouls | 5,141 | 13.166 | 4.349 | 1 | 10 | 13 | 16 | 34 |
| Home corners | 5,141 | 5.605 | 3.012 | 0 | 3 | 5 | 7 | 23 |
| Away corners | 5,141 | 4.533 | 2.627 | 0 | 3 | 4 | 6 | 16 |
| Home yellow cards | 5,141 | 1.961 | 1.401 | 0 | 1 | 2 | 3 | 8 |
| Away yellow cards | 5,141 | 2.262 | 1.432 | 0 | 1 | 2 | 3 | 8 |
| Home red cards | 5,141 | 0.093 | 0.313 | 0 | 0 | 0 | 0 | 3 |
| Away red cards | 5,141 | 0.127 | 0.357 | 0 | 0 | 0 | 0 | 2 |
| Average age home | 5,141 | 26.201 | 1.453 | 22 | 25.2 | 26.3 | 27.2 | 30 |
| Foreigners share home | 5,141 | 0.567 | 0.176 | 0.010 | 0.438 | 0.593 | 0.701 | 0.940 |
| Crowd Size | 5,141 | 24.416 | 17.852 | 1.969 | 10.897 | 19.369 | 35.191 | 81.171 |
| Occupancy rate | 5,141 | 0.724 | 0.219 | 0.077 | 0.570 | 0.783 | 0.916 | 1.000 |
| Average age away | 5,141 | 26.202 | 1.452 | 22.500 | 25.200 | 26.300 | 27.200 | 30.400 |
| Foreigners share away | 5,141 | 0.566 | 0.177 | 0.010 | 0.438 | 0.593 | 0.702 | 0.940 |
| Spi rating home | 5,141 | 60.391 | 15.698 | 21.450 | 48.090 | 61.620 | 71.370 | 95.750 |
| Spi rating away | 5,141 | 60.272 | 15.666 | 21.150 | 47.670 | 61.510 | 71.150 | 95.470 |
| Importance rating home | 5,100 | 33.891 | 24.583 | 0.000 | 14.775 | 31.200 | 48.700 | 100.000 |
| Importance rating away | 5,100 | 32.883 | 24.330 | 0.000 | 13.700 | 29.800 | 47.700 | 100.000 |
| Expected goals home | 3,665 | 1.569 | 0.877 | 0.000 | 0.930 | 1.420 | 2.060 | 7.070 |
| Expected goals away | 3,665 | 1.254 | 0.789 | 0.000 | 0.660 | 1.100 | 1.690 | 5.900 |
| Yellow card difference | 5,141 | 0.301 | 1.755 | -7 | -1 | 0 | 1 | 7 |
| Rating difference | 5,141 | 0.120 | 15.664 | -58.310 | -9.280 | 0.170 | 9.670 | 62.270 |
| Expected goals difference | 3,665 | 0.314 | 1.273 | -5.340 | -0.480 | 0.300 | 1.080 | 6.790 |
| Age difference | 5,141 | -0.001 | 1.574 | -5.000 | -1.100 | 0.000 | 1.100 | 5.000 |
| Red card difference | 5,141 | 0.034 | 0.461 | -3 | 0 | 0 | 0 | 2 |
| Importance difference | 5,100 | 1.008 | 31.979 | -100.000 | -16.900 | 0.100 | 19.025 | 100.000 |
| Percentage home wins | 5,141 | 0.454 | 0.498 | 0 | 0 | 0 | 1 | 1 |
| Percentage away wins | 5,141 | 0.299 | 0.458 | 0 | 0 | 0 | 1 | 1 |
| Percentage draws | 5,141 | 0.247 | 0.431 | 0 | 0 | 0 | 0 | 1 |
| Home points | 5,141 | 1.609 | 1.321 | 0 | 0 | 1 | 3 | 3 |
| Away points | 5,141 | 1.145 | 1.277 | 0 | 0 | 1 | 3 | 3 |
| Goal difference | 5,141 | 0.362 | 1.858 | -9 | -1 | 0 | 1 | 10 |
| Points difference | 5,141 | 0.464 | 2.562 | -3 | -3 | 0 | 3 | 3 |
| Foul difference | 5,141 | 0.293 | 5.255 | -18 | -3 | 0 | 4 | 24 |
| Foreigners share difference | 5,141 | 0.0002 | 0.214 | -0.720 | -0.139 | 0.000 | 0.144 | 0.752 |
| Percentage points home | 5,141 | 0.577 | 0.427 | 0 | 0 | 0.5 | 1 | 1 |
| Percentage points away | 5,141 | 0.423 | 0.427 | 0 | 0 | 0.5 | 1 | 1 |
| Corner difference | 5,141 | 1.072 | 4.481 | -14 | -2 | 1 | 4 | 20 |
| Shots difference | 5,141 | 8.812 | 6.531 | -14 | 4 | 8 | 13 | 34 |
| Shots on target difference | 5,141 | 0.961 | 3.804 | -20 | -1 | 1 | 3 | 17 |
| Percentage points difference | 5,141 | 0.155 | 0.854 | -1 | -1 | 0 | 1 | 1 |

|  |  |  |  |
| --- | --- | --- | --- |
| **Normality test** | | | |
|  | **Test Statistic** | **P value** | **Alternative Hypothesis** |
| Percentage points Home | 794.3 | *p* <.001 \* \* \* | *Variable not normally distributed* |
| Points Home | 886.1 | *p* <.001 \* \* \* | *Variable not normally distributed* |
| Home Goals | 306.3 | *p* <.001 \* \* \* | *Variable not normally distributed* |
| Percentage home Wins | 1494 | *p* <.001 \* \* \* | *Variable not normally distributed* |
| Expected goals Home | 71.81 | *p* <.001 \* \* \* | *Variable not normally distributed* |
| Home Shots | 52.31 | *p* <.001 \* \* \* | *Variable not normally distributed* |
| Home Shots on Target | 97.15 | *p* <.001 \* \* \* | *Variable not normally distributed* |
| Home Fouls | 31.5 | *p* <.001 \* \* \* | *Variable not normally distributed* |
| Home Red | 2660 | *p* <.001 \* \* \* | *Variable not normally distributed* |
| Home Yellow | 217.6 | *p* <.001 \* \* \* | *Variable not normally distributed* |
| Percentage points Away | 794.3 | *p*  <.001 \* \* \* | *Variable not normally distributed* |
| Points Away | 914.8 | *p*  <.001 \* \* \* | *Variable not normally distributed* |
| Away Goals | 389.3 | *p*  <.001 \* \* \* | *Variable not normally distributed* |
| Percentage Away wins | 1734 | *p* <.001 \* \* \* | *Variable not normally distributed* |
| Expected goals Away | 85.07 | *p* <.001 \* \* \* | *Variable not normally distributed* |
| Away Shots | 57.83 | *p* <.001 \* \* \* | *Variable not normally distributed* |
| Away Shots on Target | 116.9 | *p* <.001 \* \* \* | *Variable not normally distributed* |
| Away Yellow | 200.9 | *p* <.001 \* \* \* | *Variable not normally distributed* |
| Away Red | 2514 | *p* <.001 \* \* \* | *Variable not normally distributed* |
| Away Fouls | 33.29 | *p* <.001 \* \* \* | *Variable not normally distributed* |
| Goal difference | 110.8 | *p* <.001 \* \* \* | *Variable not normally distributed* |
| Foul difference | 12.45 | *p* <.001 \* \* \* | *Variable not normally distributed* |
| Red card difference | 1751 | *p* <.001 \* \* \* | *Variable not normally distributed* |
| Yellow card difference | 111.7 | *p* <.001 \* \* \* | *Variable not normally distributed* |
| Points difference | 794.3 | *p* <.001 \* \* \* | *Variable not normally distributed* |
| Expected goals difference | 5.64 | *p* <.001 \* \* \* | *Variable not normally distributed* |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Significance test** | | | | |
|  | **Test Statistic** | **Tie factor** | **P value** | **Alternative hypothesis** |
| Percentage points Home | .5282 | .8707 | *p* < .001 \* \* \* | *Two distributions are not equal* |
| Points Home | .5282 | .8707 | *p* < .001 \* \* \* | *Two distributions are not equal* |
| Home Goals | .5244 | .9367 | *p* < .001 \* \* \* | *Two distributions are not equal* |
| Percentage home Wins | 74.252 | - | *p* < .001 \* \* \* | *Two distributions are not equal* |
| Expected goals Home | .5406 | 1 | *p* < .001 \* \* \* | *Two distributions are not equal* |
| Home Shots | .5605 | .9962 | *p* < .001 \* \* \* | *Two distributions are not equal* |
| Home Shots on Target | .5462 | .9854 | *p* < .001 \* \* \* | *Two distributions are not equal* |
| Home Fouls | .4802 | .9946 | *p* = .0028 \* \* | *Two distributions are not equal* |
| Home Red | .4977 | .2412 | *p* = .4763 | *Two distributions are not equal* |
| Home Yellow | .4915 | .9508 | *p* = .1898 | *Two distributions are not equal* |
| Percentage points Away | .4718 | .8707 | *p*  < .001 \* \* \* | *Two distributions are not equal* |
| Points Away | .4718 | .8707 | *p*  < .001 \* \* \* | *Two distributions are not equal* |
| Away Goals | .4791 | .9191 | *p*  < .001 \* \* \* | *Two distributions are not equal* |
| Percentage Away wins | 74.252 | - | *p* < .001 \* \* \* | *Two distributions are not equal* |
| Expected goals Away | .4846 | 1 | *p* = .04 \* | *Two distributions are not equal* |
| Away Shots | .4918 | .9954 | *p* < .001 \* \* \* | *Two distributions are not equal* |
| Away Shots on Target | .5016 | .9819 | *p* = .8079 | *Two distributions are not equal* |
| Away Yellow | .5542 | .9534 | *p* < .001 \* \* \* | *Two distributions are not equal* |
| Away Red | .5098 | .298 | *p* = ..006 \* \* | *Two distributions are not equal* |
| Away Fouls | .5128 | .9948 | *p* = .053 | *Two distributions are not equal* |
| Goal difference | .53 | .9683 | *p* < .001 \* \* \* | *Two distributions are not equal* |
| Foul difference | .5258 | .9966 | *p* < .001 \* \* \* | *Two distributions are not equal* |
| Red card difference | .5113 | .4351 | *p* < .001 \* \* \* | *Two distributions are not equal* |
| Yellow card difference | .5518 | .9679 | *p* < .001 \* \* \* | *Two distributions are not equal* |
| Points difference | .5282 | .8707 | *p* < .001 \* \* \* | *Two distributions are not equal* |
| Expected Goals Difference | .5364 | 1 | *p* < .001 \* \* \* | *Two distributions are not equal* |

|  |  |  |
| --- | --- | --- |
| **Vif table** | | |
|  | **Indirect path** | **Direct path** |
| Yellow Card Difference | - | 1.044697 |
| Covid | 1.101376 | 1.044697 |
| Crowd Size | 3.105528 | 3.117182 |
| Occupancy Rate | 3.765799 | 1.945827 |
| Foreigners Share | 1.697665 | 1.716020 |
| Age Difference | - | 1.618824 |
| Importance Difference | 1.193046 | 1.192124 |
| Rating Difference | 1.770686 | 1.548321 |
| VAR | 1.569013 | 1.568180 |
| Shots Difference | 1.323969 | - |
| League | 4.672166 | 4.549598 |
| Covid:Crowd Size | 2.632341 | 2.640759 |
| Covid:Age Difference | - | 1.612369 |
| Covid:Foreigners Share | 1.615126 | 1.63399 |
| Covid:Occupancy Rate | 2.720148 | 2.723399 |