Does Humidity Affect Offensive Performance in Major League Baseball?

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Abstract

This paper examines the impact of environmental ballpark conditions on offensive performance in Major League Baseball, with a direct focus on the role of average humidity percentage. Using data for all thirty teams across four seasons, ranging from 2021 to 2024, the study evaluates whether variations in average humidity percentages of different ballparks influence home weighted on-base average (wOBA). Weighted on-base average is superior to older metrics such as batting average or on-base plus slugging (OPS), as these variables favor specific types of hitters and do not encapsulate offensive production in a single integer. To test the hypothesis, the paper runs multiple linear regression models on a panel dataset using home wOBA as the dependent variable and average humidity percentage as the variable of interest. The baseline specification accounts for the control variables of average fan attendance, hitting coaches' years of service, average ballpark dimensions, and average temperature. Additional alternative specifications added two new variables of position player payroll and sprint speed, yearly fixed effects, the natural logarithm of position player payroll, and removal of the outliers for home weighted on-base average. While average humidity percentage appears to have a statistically significant relationship with home wOBA at the $\alpha = .05$ level, the significance disappears once additional control variables are introduced. The fully specified models that incorporate new alternative specifications show that average humidity does not have a statistically significant effect on offensive production. This suggests that potential physical and physiological effects may offset one another.

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Introduction

In Major League Baseball, even minor changes in ballpark conditions can have a meaningful impact on the results of a game. A difference of inches can separate a routine flyout from a homerun and a fair ball from a foul ball. Due to these small margins, environmental factors are an important component of offensive performance across the league. While variables such as ballpark elevation, temperature, and wind speed have been widely studied, humidity has received much less attention in comparison. From a physical aspect, humid air contains a higher concentration of water vapor, which decreases its density. Greater air density, which occurs in drier environments, causes objects to lose velocity more quickly and travel a shorter distance. The density of humid air is lower because water vapor is less dense than dry air, as water vapor molecules are lighter than the nitrogen and oxygen molecules that make up dry air. Although it would be natural to assume that these environments would favor a higher output of offensive production, humidity presents significant physiological effects, including increased fatigue, dehydration, and cardiovascular stress. This paper provides empirical evidence that humidity does not have a significant impact on offensive performance in Major League Baseball once all relevant control variables are included, suggesting that the physiological tolls likely offset the physical benefits of reduced air density.

To determine the relationship between humidity and offensive production, this study utilizes the method of ordinary least squares regression using data from all thirty Major League Baseball teams over the 2021 through 2024 seasons. Home weighted on-base average is used as the dependent variable measuring offensive performance, while average humidity percentage serves as the independent variable of interest. The baseline specification adds controls for the variables of average fan attendance, hitting coach years of service, average ballpark dimensions, and average temperature. Ballpark elevation, although proven significant, had to be dropped from the series of regressions, as it caused the variable of interest to suffer from multicollinearity due to ballpark elevation being inversely correlated with average humidity and average temperature. Average total home plate appearances also dropped as a variable due to severe endogeneity. After the baseline regression, four new alternative specifications were introduced to test the quality of the results. One alternative specification adds two new variables: position player payroll measured in dollars, and sprint speed measured in feet per second. Other alternative specifications add year fixed effects, the natural logarithm of position player payroll, and outlier adjustment through removing the top and bottom ten values of the dependent variable. In the baseline specification, average humidity percentage remains statistically significant at the $\alpha = 0.05$ level. However, once the average temperature is introduced as the last control variable of the baseline specification, the humidity coefficient loses statistical significance. This is likely due to temperature capturing variation in environmental conditions that humidity cannot necessarily capture on its own, which led to omitted variable bias in prior results. The addition of temperature helps to better capture the true independent effect of average humidity percentage. Throughout the introduction of alternative specifications, two control variables proved to be significant. Average fan attendance was consistently significant at the $\alpha=0.01$ level. Average temperature was also significant at the $\alpha=0.01$ level once it was introduced. The coefficient of average fan attendance was 7.08324E-07, meaning for each extra fan a team has attended their games on average, there is a 7.08324E-07 increase in batting average. This coefficient is also extremely minuscule, but fan attendance fluctuates in the thousands. For example, a team such as the Yankees has an average fan attendance of 40,207, while the Marlins only have an average attendance of 7,933. That coefficient becomes much larger with a 30,000 or more-attendance difference. Through the introduction of alternative specifications, the behavior of the control variables helps to provide a further quality check of the results. Average fan attendance remains statistically significant at the $\alpha = 0.01$ level across most specifications, which indicates a consistent positive relationship between crowd size and home offensive production. When the natural logarithm of position player payroll is introduced, average fan attendance remains significant, but it declines to significance at the $\alpha = 0.05$ level. This highlights the comparable elements between position player payroll and fan attendance, as teams with higher payrolls tend to have a higher average fan attendance, given that they are large market organizations. Average temperature also remains statistically significant at the $\alpha = 0.01$ level across most specifications, but its level of significance decreases to $\alpha = 0.05$ with the removal of outliers in home weighted-on-base average. This indicates that extreme offensive performances make a large contribution to the strength of temperature as a variable. Position player payroll is not statistically significant when measured raw, but it becomes significant once changed through using its natural logarithm. Overall, average humidity becomes insignificant after adding a control for temperature, and across alternative specifications. These results support the thesis that humidity does not affect offensive performance in Major League Baseball, as measured through home wOBA.

1. Background

The objective of this research project is to determine how ballpark conditions, specifically average humidity percentage, influence offensive performance. Offensive performance is measured with home weighted on-base-average (wOBA) as a dependent variable to further evaluate if environmental ballpark factors have an impact on a team’s offensive success. Understanding the relationship between environmental factors and offensive output is crucial in determining if any teams have a distinct advantage playing at home. Insights into how environmental conditions affect offensive efficiency are valuable in informing pro-organizations of how specific environmental ballpark factors correlate to offensive output. This could allow them to approach these games with a different game plan. An advantage in batting efficiency leads to an overall higher production, which directly correlates with a team's financial success through ticket sales and free agent acquisitions. This research study could guide teams in designing specific training programs and adjusting strategies based on the distinct characteristics of specific ballparks. Breaking down the physics along with the physiological toll of the game adds an entirely new variable to a team's success. Identifying whether environmental ballpark factors meaningfully impact offensive production has strong relevance for professional organizations. From a theoretical standpoint, humidity could affect how a ball travels through changes in air density, but humid conditions also place additional physiological stress that is not always accounted for. Due to these opposing effects, this study empirically analyzes whether humidity remains significant once relevant control variables are included. This helps teams determine whether humidity represents a significant source of competitive advantage in Major League Baseball.

While factors such as ballpark elevation, temperature, and wind speed have been widely studied, humidity has received much less attention in comparison despite the relationship it shares with other environmental factors. Average humidity is particularly relevant, as it affects both the physical properties of air density and the physiological demands these environments place on athletes. Although humid air is less dense and can favor the distance a baseball travels, higher humidity levels can increase fatigue, dehydration, and other forms of cardiovascular strain within athletes. Given the inverse relationship between ballpark elevation and humidity, focusing on humidity provides an alternative perspective on the way environmental conditions can contribute to shaping outcomes of games in Major League Baseball.

2. Literature Review

Numerous studies have explored the relationship between environmental factors and baseball performance. For instance, Segreti et al. (2024) studied the effects of environmental factors on athletes' cardiovascular systems. This provides a different perspective on offensive efficiency by performing a physiology-based study rather than just assessing the physics aspect of the sport. The velocity and distance a baseball can travel based on environmental conditions depend on the condition the athlete is in. Although humid environments favor hitters in terms of the reduced air resistance, "when exposed to elevated outdoor temperatures and humidity, athletes are at an increased risk of excessive fluid loss and exertional heat illness" (Segreti et al., 2024, p. 1). Another important factor is that "baseball hitting requires the performance of high-level cognitive functions, including visual search, anticipation of the pitch trajectory, and inhibitory control, within approximately 350 milliseconds" (Huang et al., 2021, p. 3251). Ultimately, understanding the combined effects of environmental and physiological factors is essential for optimizing offensive production while minimizing health risks across different ballpark conditions.

Although humidity has been studied in relation to its negative physiological effects, such as increased fatigue and the risk of heat-related illnesses, much of the existing research focuses solely on these health concerns rather than its direct impact on offensive performance in baseball. There is minimal research comparing the air density of humidity and the potential advantages it could give towards offensive production in comparison to the physiological tolls these environments have on players. Previous studies have evaluated advantageous variables in baseball specifically, such as "the support of the home audience, travel fatigue of the away team, familiarity with the home venue, and (in some sports) competition rules that might favor the home team" (Allen & Jones, 2014). In baseball, the rules that would favor the home team would be the home team batting in the bottom half of each inning, in conjunction with the tiebreaker rule in extra innings. The extra innings rule now enables a runner to start on second base, so a home team making it to the bottom half of an extra inning without surrendering a run could hypothetically bunt the runner over to third base and would only need to advance one extra base with two outs to spare to win the game. The evolution of these rules in baseball has changed the game for home teams, as "during the 19th Century teams often preferred to bat first, so that they would have first opportunity to bat using the game ball, which was likely to be the only new ball used during the game" (Simon & Simonoff, 2006). With the implementation of the extra innings rule, teams no longer saw an advantage in batting first, as it could harm them down the stretch and dictate outcomes against them. While these rules are extremely advantageous towards home team success in conjunction with the other variables mentioned above, there are minimal studies evaluating the ballpark environmental factors alone.

An additional piece of economic literature oriented around baseball studies the importance of accurately measuring offensive production through advanced metrics. This is known as the *Moneyball* framework, which attempts to measure the inefficiency of the Major League Baseball market. The theory started when "financial reporter Michael Lewis made a striking claim: the valuation of skills in the market for baseball players was grossly inefficient. The discrepancy was so large that when the Oakland Athletics hired an unlikely management group consisting of Billy Beane, a former player with mediocre talent, and two quantitative analysts, the team was able to exploit this inefficiency and outproduce most of the competition, while operating on a shoestring budget" (Hakes & Sauer, 2006, p. 173). This season of success caused a "firestorm of criticism from baseball insiders" (Hakes & Sauer, 2006). Hakes and Sauer (2006) test the claim popularized by Lewis that certain offensive skills were undervalued in Major League Baseball's market. Using a regression analysis, they demonstrate that on-base percentage is a particularly strong predictor of team success, finding that "linear combinations of on-base percentage and slugging percentage are very highly correlated with runs scored, the primary objective of an offense" (Hakes & Sauer, 2006). Their results also show that on-base percentage contributes more than twice as much to win rate as slugging percentage does. This piece of literature directly correlates to the study, as the study builds directly on these principles through the implementation of weighted on-base average as a dependent variable. This allows for an accurate measure of offensive performance while examining how environmental factors can influence these results.

This paper expands on the work of these authors by investigating the average humidity percentage of the ballparks of all thirty teams as the primary independent variable and examining its relationship with wOBA, an advanced metric of athletic performance. Additionally, this paper includes other controls such as average fan attendance, hitting coach years of service for the team, sprint speed, position player payroll, average ballpark dimensions, and average temperature to account for additional environmental influences on the game. Through taking this approach to account for a broad range of variables, this study aims to provide a more comprehensive understanding of how humidity, alongside other ballpark factors, contributes to variations in offensive performance. Through analyzing physical and physiological factors, this study not only offers insights into how the environment can shape offensive player performance, but it also identifies potential strategies for teams to adapt based on different playing conditions. Ultimately, this study seeks to bridge the gap in previously published studies and offers insights to act on for managers, coaches, and analysts aiming to optimize team performance by accounting for the different environmental variables that dictate the outcomes of ball games.

3. Data

Table 1

Descriptive Statistics of MLB Teams (2021-24)

	Mean	Std Deviation
Weighted On Base Average	0.318	0.018
Average Humidity	0.682	0.106
Average Fan Attendance	26135.525	9539.481
Hitting Coach Years Of Experience	2.071	2.166
Average Ballpark Dimension	354.566	6.649
Average Temperature	73.129	3.934
Windspeed	6.900	1.111
Ballpark Elevation	517.600	932.578
Position Player Payroll	80184003.53	38710652.9
Sprint Speed	27.3125	0.379199178

Note: Humidity is a percentage expressed as a decimal.

The numbers in the above table consist of all the means and standard deviations of all the variables from my dataset after running descriptive statistics for each one independently. The Y variable wOBA means weighted on-base average, as 0.318 indicates the average wOBA of all thirty MLB teams. The mean for average humidity, my X variable of interest, is 0.682 with a standard deviation of 0.106. Humidity is a percentage-based variable; therefore, a mean of 0.682 indicates the average humidity percentage across all MLB ballparks over the last four seasons is 68.2%. My control variables consist of average fan attendance, hitting coach years of service for the team, wind speed, average temperature, ballpark elevation, and ballpark dimensions. The average fan attendance was 26,135.525 with a standard deviation of 9,539.481. Some teams had an average fan attendance above 40,000, while other franchises failed to break 10,000. This led to a massive standard deviation. The same goes for ballpark elevation, as the mean was 517.600 feet above sea level with a standard deviation of 932.578 feet. There are large outliers in ballpark elevation, as Coor's Field in Colorado is 5,183 feet above sea level. Wind speed is measured in miles per hour, which indicates the average wind speed across all thirty MLB ballparks is 6.900 mph with a standard deviation of 1.111. The average temperature is measured in degrees Fahrenheit, with an average temperature of 73.129 degrees with a standard deviation of 3.934. The hitting coaches' years of service for the current team had a mean of 2.071 years with a standard deviation of 2.166. Average ballpark dimension had a mean of 354.566 feet with a standard deviation of 6.649. Ballpark dimension was calculated by adding the distances of left, center, and right field and averaging out the total to receive one number to use throughout the regressions. The mean of position player payroll was $80,184,003.53 with a standard deviation of $38,710,652.9. The enormous standard deviation is due to the outliers in small and large market teams, such as the Athletics, in comparison to the Dodgers. The final control variable is sprint speed, which was measured in feet per second. The mean was 27.3125 feet with a standard deviation of 0.379, indicating that there are no significant sprint speed outliers throughout the data.

For this panel dataset, I obtained these statistics through a multitude of different sources. Weighted-on-base-average and sprint speed data were gathered through Baseball Savant's official statcast website. Average humidity percentage, wind speed, and average temperature were all gathered through the Weather World database, which gives access to weekly, monthly, and yearly average weather statistics for all thirty MLB ballparks. Ballpark dimension statistics were acquired through the Ballparks of Baseball website, which provides the distance to left, center, and right field of each ballpark on the website and documents them in an Excel spreadsheet. Ballpark elevation information was found through Sports Library's website, documenting the elevation of each ballpark, and average fan attendance was gathered directly through ESPN, with information for all thirty teams over the past four seasons. Hitting coach years of service did not have any consistent data documented under a single source, leading me to research each team individually to discover the tenure of each coach. All variables consist of data from the past four seasons (2021-2024) for all thirty MLB teams, excluding stagnant variables such as ballpark elevation and average ballpark dimension. Finally, position player payroll information was found through Spotrac, which is a team salary tracker for all sports.

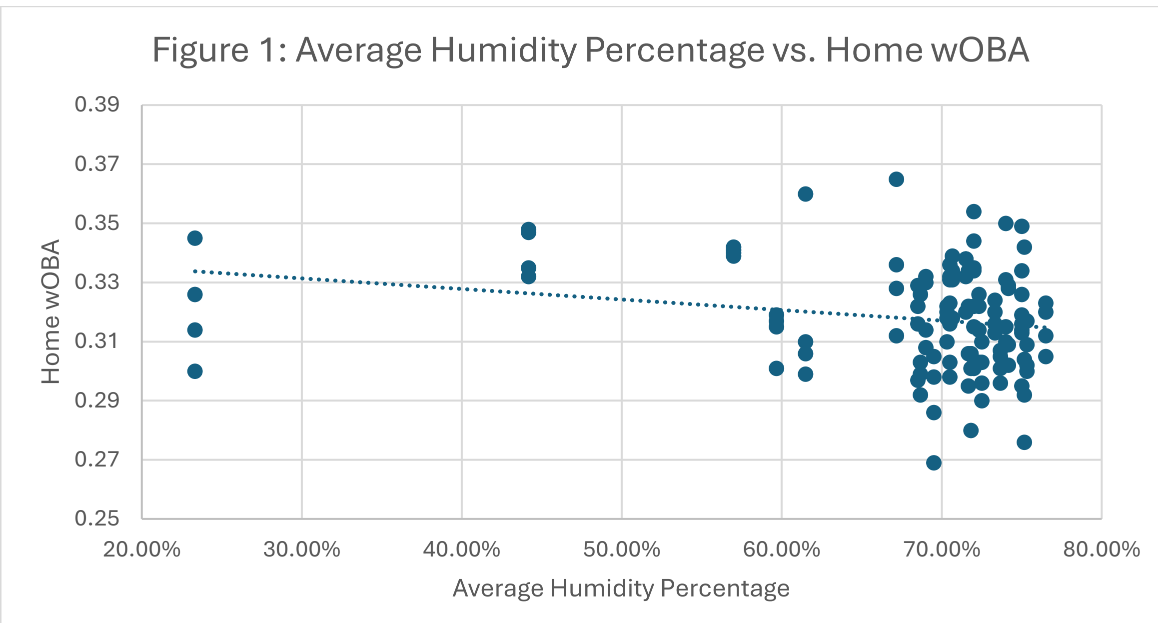

Figure 1 presents a scatterplot of the average humidity percentage of all thirty ballparks across the 2021-2024 seasons versus the home weighted on-base average of each team within the respective seasons. The figure demonstrates a broad spread of observations in offensive performance across a wide range of humidity levels. There is no clear or consistent visual relationship between average humidity and home weighted on-base average. The absence of a clear pattern highlights the need for a regression analysis after accounting for all the relevant control variables.

4. Methodology

In this paper, I perform an empirical analysis using data from 30 MLB teams over the last 4 seasons to show that average humidity percentage does not have a statistically significant effect on offensive production, as measured through home weighted on-base average. To do so, I utilize the method of ordinary least squares regression to estimate five different specifications, including a baseline model and several alternative specifications to test the quality of the results. The general form of the regression equation is presented below:

$$WeightedOnBaseAverage_{it} = \beta_0 + \beta_1 AverageHumidityPercentage_{it} + \gamma X_{it} + \varepsilon_{it}$$

Where X represents a set of controls that includes average fan attendance, years of service the hitting coach has for the team, average temperature in degrees Fahrenheit, and average ballpark dimension in feet. Additional specifications account for two new variables of position player payroll measured in dollars and sprint speed measured in feet per second, year fixed effects, the natural logarithm of position player payroll, and outlier adjustments to home weighted on-base average.

5. Empirical Results

Table 2
Regression Results: Impact on wOBA

	(1)	(2)	(3)	(4)	(5)
Humidity	-0.036**	-0.030**	-0.031**	-0.033**	-0.022
	(0.015)	*(0.014)*	*(0.014)*	*(0.013)*	*(0.014)*
Average Fan Attendance		0.001***	0.001***	0.001***	0.001***
		(1.513E-04)	*(1.584E-04)*	*(1.580E-04)*	*(1.540E-04)*
Hitting Coach Years of Service			0.001	0.001	0.001
			(1.540E-04)	*(7.050E-04)*	*(6.850E-04)*
Average Ballpark Dimension				-2.737E-04	-3.137E-04
				(2.240E-04)	*(2.190E-04)*
Average Temperature					0.001***
					(3.780E-04)

*** indicates significance at α = .01, ** indicates significance at α = .05, * indicates significance at α = .10

The above table displays the results from the baseline regression specifications, as it examines the relationship between average ballpark humidity and home wOBA. In the earlier baseline specifications, average humidity percentage appears statistically significant at the α=0.05 level. This initial significance from the coefficient of interest reflects the relationship between humidity and offensive production before including additional environmental and team-oriented control variables. As the baseline specification expands, changes in the level of significance for average humidity percentage indicate that the relationship between humidity and offensive production is sensitive to the inclusion of alternative specifications and controls.

These empirical results indicate that average humidity percentage does not have a statistically significant effect on offensive performance, as measured by home weighted on-base average. In the fully specified regressions, the estimated effect of average humidity is indistinguishable from zero. This indicates no statistically significant relationship between humidity and offensive production. As a result, the coefficient does not provide evidence of a meaningful effect in either direction. One possible interpretation of the relationship being insignificant is that the physical effects associated with humidity are offset by opposing physiological factors.

Through my five regressions contributing to the baseline, average humidity appeared to suffer from omitted variable bias through the implementation of average temperature. Before the addition of average temperature, the coefficient of average humidity is consistently significant at the $\alpha = 0.05$ level, but once average temperature is included, it becomes insignificant with a p-value of 0.125. Although the added control variables did not change any of my other coefficients or p-values drastically, adding average temperature into the regression showed the X variable of interest appeared more significant than it truly was. Along with my X variable of interest suffering from omitted variable bias, three of the coefficients were not significant in any of the regressions, as their p-values also exceeded 0.10. The hitting coach's years of experience with the team and average park dimension were not significant at the $\alpha = 0.01$, $\alpha = 0.05$, or $\alpha = 0.10$ level. Average fan attendance and average temperature remained consistently significant at the $\alpha=0.01$ level throughout the regressions they were included in, with both having a coefficient of 0.001. For average fan attendance, this number represents the increase associated with each additional thousand fans, as I scaled the average fan attendance variable by dividing it by 1,000 in the regressions. For example, instead of using the Dodgers' average attendance in 2022 of 47,671 fans, I expressed it as 47.671. This adjustment simplifies the model and interprets coefficients less tediously. For average temperature, a coefficient of 0.001 indicates that for each one-degree Fahrenheit increase in temperature is a 0.001 increase in weighted-on-base-average.

Table 3

Alternative Specifications: Impact on wOBA

	(1)	(2)	(3)	(4)	(5)
Humidity	-0.022	-0.022	-0.019	-0.022	-0.001
	(0.014)	*(0.014)*	*(0.013)*	*(0.014)*	*(0.013)*
Average Fan Attendance	0.001***	0.001***	0.001***	4.938E-04**	4.974E-04***
	(1.540E-04)	*(2.247E-04)*	*(1.505E-04)*	*(2.068E-04)*	*(1.355E-04)*
Hitting Coach Years of Service	0.001	0.001	0.001	0.001	0.001
	(6.850E-04)	*(0.001)*	*(0.001)*	*(0.001)*	*(0.001)*
Average Ballpark Dimension	-3.137E-04	-3.137E-04	-3.313E-04*	-3.260E-04	*-1.866E-05*
	(2.190E-04)	*(2.212E-04)*	*(1.990E-04)*	*(2.159E-04)*	*(2.077E-04)*
Average Temperature	0.001***	0.001***	0.001***	0.001***	0.001**
	(3.780E-04)	*(3.887E-04)*	*(3.459E-04)*	*(3.739E-04)*	*(3.173E-04)*
Position Player Payroll		5.946E-11		0.001**	
		(5.527E-11)		*(3.118E-03)*	
Sprint Speed (ft/sec)		-0.001			
		(0.004)			
Annual Fixed Effects	No	No	Yes	No	No
Natural Log - Position Player Payroll	No	No	No	Yes	No
Remove Y Outliers	No	No	No	No	Yes

*** indicates significance at α = .01, ** indicates significance at α = .05, * indicates significance at α = .10

The first alternative specification incorporated into Table 3 expands on the baseline regression through the addition of two new variables. The two additional control variables implemented into the second column of Table 3 are both position player payroll and average sprint speed. These variables were included to account for differences in player athleticism and financial investments across teams, as both factors can heavily influence offensive production independently. Position player payroll negates potential biases rooted in large market teams having a distinct advantage over small market teams in terms of financial constraints and free agent acquisitions. Failing to account for this could disrupt the results of environmental factors, as teams with higher payrolls also play in different types of climate conditions in select ballparks. The implementation of sprint speed also prevents biases against lineups that are built around athleticism and on-base efficiency rather than slugging alone. This ensures that offensive production driven by speed and baserunning is not improperly credited to environmental conditions. The addition of the two variables did not alter the statistical significance of average humidity, as it remains insignificant in this specification and throughout the rest of the table. Including these controls also did not disrupt the consistency of the coefficients across the other control variables. This indicates that the results are not sensitive to the inclusion of payroll and athleticism-related control variables.

The second alternative specification introduces year fixed effects to modify the baseline regression. This approach eliminates omitted variable bias within a panel dataset from unobserved, time-specific factors that could affect all teams within a given season but vary across different seasons. This could be achieved through the implementation of new rules, league-wide shifts in pitching and offensive strategies, or broader variables of change that can create bias within the regression. Accounting for season-level effects allows the regression to isolate variation in humidity and offensive performance within a specific year. The inclusion of year fixed effects did not cause any changes to the control variables, excluding a mild increase in the coefficient of average ballpark dimension.

The third alternative specification adjusts the baseline regression by using the natural logarithm of position player payroll rather than the raw payroll value. This transformation accounts for the idea that spending more is not as helpful once a team already has a high payroll. This makes the relationship between position player payroll and weighted on-base average likely exponential because increases in player budget allocation tend to produce proportional results rather than constant ones. For example, a payroll increase from $40 million to $60 million allows a smaller budget team to significantly improve, whereas a team increasing payroll from $180 million to $200 million is more likely to result in a smaller effect on overall offensive performance, even though it is the same dollar increase. As a result, high payroll teams still matter without completely overwhelming the regression results, which is a step in attempting to prevent outliers from significantly swaying results. In reference to the baseline specification, the levels of significance remained unchanged, and the remaining control variables showed very minimal changes, excluding average fan attendance. With the implementation of the natural logarithm of position player payroll, average fan attendance was no longer significant at $\alpha = .01$. Average fan attendance proved to be significant at $\alpha = .05$. Position player payroll also went from being insignificant to having significance at the $\alpha = .05$ level.

The final alternative specification tests the validity of the results through the removal of outliers for home weighted on-base average, the dependent variable. The top ten and bottom ten observations were dropped from the regression, as these excluded observations represent extreme offensive performances that could cause the results to be misleading. Removing these outliers helps to decipher whether the baseline results are heavily impacted by unusually high or low-performing teams over the course of the four years. For the control variables, there were subtle differences in coefficients between the baseline specification and the outlier removal specification. The two differences in significance were that average temperature no longer had significance at $\alpha = .01$ and instead had significance at $\alpha = .05$, and average fan attendance adjusted from being significant at $\alpha = .05$ to $\alpha = .01$.

Overall, the results from Tables 2 and 3 show that average humidity does not have a statistically significant effect on home offensive production in Major League Baseball once relevant control variables are included. While average humidity initially appears significant in the simple baseline specifications, this relationship does not persist as the model is expanded to account for additional environmental and team factors. The alternative specifications presented in Table 3 further confirm this, as the estimated effect of average humidity percentage remains insignificant throughout every alternative specification. This aligns with the hypothesis that humidity does not affect offensive baseball production, as measured through weighted on-base average. One possible interpretation is that fatigue and reduced endurance can have a strong negative impact on an athlete, which cancels out the physical benefits of humid conditions. Taking both tables together, the results suggest that environmental conditions influence offensive production in ways that extend beyond the conception of the advantages or disadvantages that average humidity percentage may bring.

Conclusion

This study provides a comprehensive analysis of the relationship between environmental factors, particularly humidity, and offensive performance across all thirty MLB teams for four seasons. This analysis implements multiple ordinary least squares regression specifications to determine the relationship between humidity and home weighted on-base average. The empirical results indicate that once environmental and team-based control variables are accounted for, average humidity does not have a statistically significant effect on offensive performance. This suggests that any apparent relationship between humidity and offensive production observed in simple specifications does not persist in more fully developed regressions with enhanced alternative specifications. One possible interpretation of this null result is the potential physical effects of changes in air density being offset by opposing physiological factors, such as increased fatigue and stress. The results highlight the complex nature of environmental influences on offensive performance in Major League Baseball.

Furthermore, this research emphasizes the importance of considering all ranges of variables that contribute to offensive performance in baseball. Average fan attendance, temperature, and the natural logarithm of position player payroll emerged as significant factors, with their effect on wOBA becoming particularly noticeable when comparing stadiums with massive attendance differences, large weather discrepancies, or franchises with outlier payroll allocation. All three of these significant control variables had a positive impact on wOBA. Although several control variables, such as hitting coach experience and average ballpark dimension, did not show significant effects, the study highlights the subtle ways in which environmental ballpark factors impact team performance. These findings encourage further investigation into the physiological, environmental, and team-based elements that influence offensive production, offering valuable insights for MLB teams looking to optimize their offensive strategies. Managers and coaches could use such information to structure their lineups and strategies based on the unique characteristics of different ballparks, gaining a potential advantage in home and away games. This research not only contributes to the ongoing conversation about environmental influences on sports performance, but it also provides actionable insights for teams looking to incorporate these factors into their preparation throughout the season and playoffs. These insights could include playing contact hitters, adapting training routines, or using different physiological preparation strategies.

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