Kimi Antonelli and Titanium Dioxide: A Quantitative Analysis

2026-05-27

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Abstract

Over the 2025 Formula One season, Andrea Kimi Antonelli, a driver for Mercedes-AMG Petronas Formula One Team, was observed to perform better in jurisdictions where titanium dioxide is a legal food additive. Using finishing position data for Grands Prix (including sprints) during the 2025 season, we found that Kimi Antonelli does finish significantly higher in races held in jurisdictions where titanium dioxide is a legal food additive; this effect is statistically significant both before and after normalization against the average constructor performance for Mercedes across Grands Prix. However, we did not find any statistical correlation between Antonelli's fastest lap time during qualifying and titanium dioxide's legal status, regardless of normalization against the team average. In addition, Antonelli's generally lackluster performance at races situated in Europe, combined with the European Union's ban on the use of titanium dioxide as a food additive, suggests that there may be other confounding variables involved in this correlational relationship.

Introduction

Andrea Kimi Antonelli is an Italian racing driver who has been competing in Formula One for Mercedes-AMG Petronas Formula One Team since the 2025 season and is currently the championship leader for the 2026 season. As the first race this year in a jurisdiction that does not allow the use of titanium dioxide as a food additive, the Monaco Grand Prix, draws ever closer, it was of great interest to us to review one of the myths that had been circulating during last year's season: whether Kimi Antonelli performs better at races in jurisdictions where it is legally allowed for titanium dioxide to be used as a food additive.

Methodology

Using data from various sources, we compiled a comprehensive dataset of the 24 Grands Prix held over the 2025 Formula One season (6 of which included sprints, for a total of 30 races). The dataset includes the legal status of titanium dioxide as a food additive in each of the jurisdictions the Grands Prix were held in, the finishing positions of Kimi Antonelli and George Russell in each race, and whether the race was held in the European Union (in which titanium dioxide is not allowed to be used as a food additive). Titanium dioxide's legal status in Azerbaijan was unclear at the time of writing, so it is labelled as 0.5; DNFs are attributed a finishing position of 21 for ease of comparison.

race	tio2	antonelli	russell
AUS	1	4	3
CHN	1	6	3
CHN-S	1	7	4
JPN	1	6	5
BHR	0	11	2
SAU	0	6	5
MIA	1	6	3
MIA-S	1	7	4
EMI	0	21	7
MON	0	18	11
ESP	0	21	4
CAN	1	3	1
AUT	0	21	5
GBR	1	21	10
BEL	0	16	5
BEL-S	0	17	12
HUN	0	10	3
NED	0	16	4
ITA	0	9	5
AZE	0.5	4	2
SIN	1	5	1
USA	1	13	6
USA-S	1	8	2
MXC	1	6	7
SAP	1	2	4
SAP-S	1	2	3
LVG	1	3	2
QAT	0	5	6
QAT-S	0	6	2
ABU	0	15	5

We also collected data on the fastest laps put in by Antonelli and Russell, as well as the pole lap, for each race during the 2025 Formula One season. The data are in units of milliseconds.

race	antonelli_quali	russell_quali	pole_quali
AUS	76525	75546	75096
CHN	91103	90723	90641
CHN-S	91738	91169	90849
JPN	87555	87318	86983
BHR	90213	90009	89841
SAU	87866	87407	87294
MIA	86271	86385	86204
MIA-S	86482	86791	86482
EMI	75772	74807	74670
MON	71880	71507	69954
ESP	72111	71848	71546
CAN	71391	70899	70899
AUT	65276	64763	63971
GBR	85374	85029	84892
BEL	102139	101260	100562
BEL-S	105394	102330	100510
HUN	76386	75425	75372
NED	69493	69255	68662
ITA	79200	79157	78792
AZE	101717	102070	101117
SIN	89537	89158	89158
USA	93114	92826	92510
USA-S	94018	92888	92143
MXC	76118	76034	75586
SAP	69685	69942	69511
SAP-S	69340	69495	69243
LVG	116314	108803	107934
QAT	79846	79662	79387
QAT-S	80532	80087	80055
ABU	83080	82645	82207

In order to measure the effects of additional confounding variables, we also included in the dataset whether races took place inside the European Union, where titanium dioxide as a food additive is banned.

race	is_european_union
AUS	0
CHN	0
CHN-S	0
JPN	0
BHR	0
SAU	0
MIA	0
MIA-S	0
EMI	1
MON	0
ESP	1
CAN	0
AUT	1
GBR	0
BEL	1
BEL-S	1
HUN	1
NED	1
ITA	1
AZE	0
SIN	0
USA	0
USA-S	0
MXC	0
SAP	0
SAP-S	0
LVG	0
QAT	0
QAT-S	0
ABU	0

Results

Given this data, we fit a linear model against the relationship between Kimi Antonelli's finishing position and the legal status of titanium dioxide as a food additive.

Figure 1: Kimi Antonelli Finishing Position and Legal Status of Titanium Dioxide as Food Additive

	Dependent variable: **antonelli**
tio2	−7.100*** (1.993)
Constant	13.502*** (1.421)
Observations	30
R2	0.312
Adjusted R2	0.287
Residual Std. Error	5.362 (df = 28)
F Statistic	12.696*** (df = 1; 28)
Note:	*p<0.1; **p<0.05; ***p<0.01

We found that Kimi Antonelli's finishing position in races during the 2025 Formula One season is strongly and negatively correlated against the legal status of titanium dioxide as a food additive, with a significance level of $p<0.01$.

In order to account for general differences in constructor performance across different circuits, we also normalized Antonelli's finishing position against the overall team performance for Mercedes across circuits by calculating the delta between Antonelli's

finishing position and the average of Antonelli's and Russell's finishing positions (i.e. `antonelli - ((antonelli + russell) / 2)`).

Figure 2: Kimi Antonelli Finishing Position (Relative to Mercedes Average) and Legal Status of Titanium Dioxide as Food Additive

	Dependent variable: antonelli_norm
tio2	−2.772*** (0.826)
Constant	4.082*** (0.589)
Observations	30
R2	0.287
Adjusted R2	0.261
Residual Std. Error	2.223 (df = 28)
F Statistic	11.257*** (df = 1; 28)
Note:	*p<0.1; **p<0.05; ***p<0.01

Again, we found that Kimi Antonelli's finishing position in races, even when normalized against Mercedes' team performance as a whole, is strongly and negatively correlated against titanium dioxide's legal status as a food additive, with a significance level of $p<0.01$.

Rather than using the qualifying position as an indicator of raw pace, as some prior literature on this topic has done, we chose to use fastest lap time during qualifying as a proportion of pole lap time as a better indicator of relative pace. Qualifying position itself is a data point that, in our view, is already reflected in race finishing position. However, it is to be noted that due to differing tyre allocations during different parts of qualifying and track evolution, it may not be on the whole completely appropriate to compare the fastest lap for a particular driver with the fastest lap overall in the context of a qualifying session.

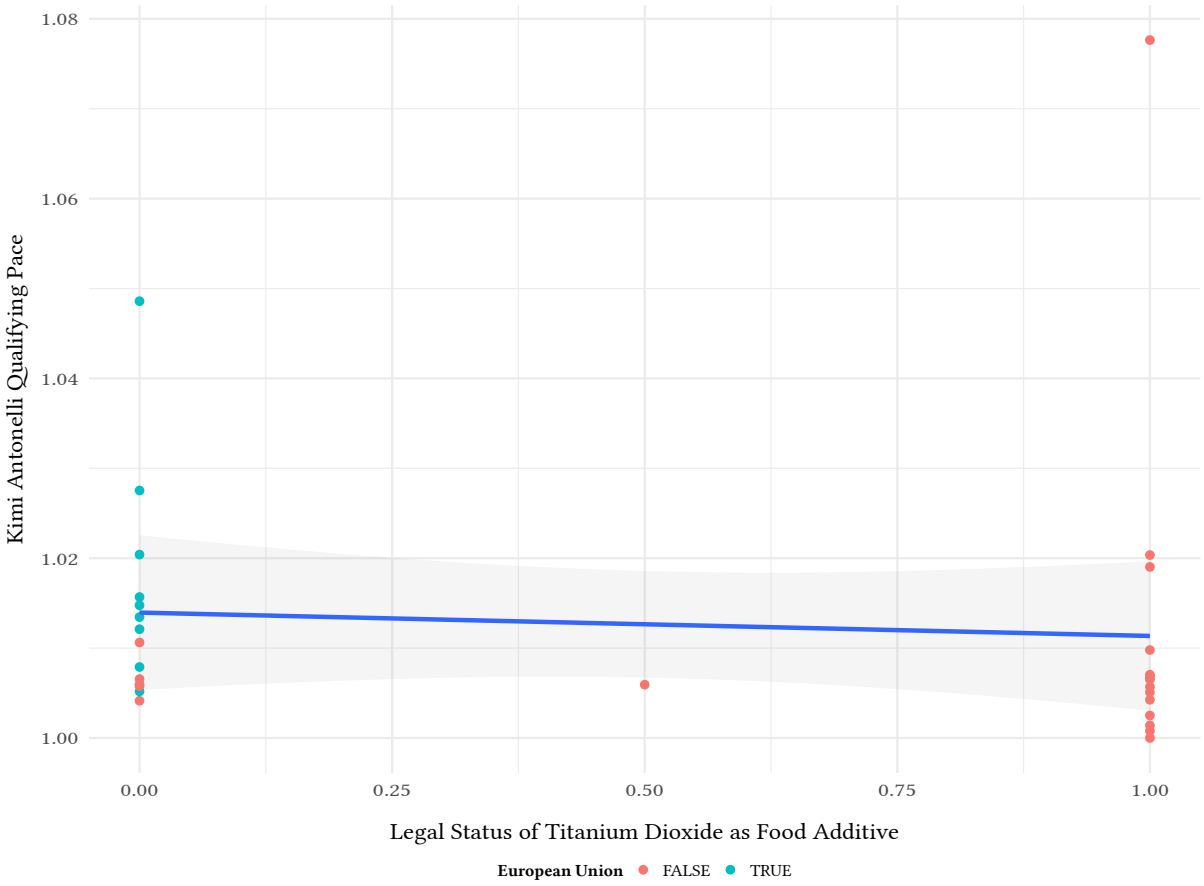

Figure 3: Kimi Antonelli Qualifying Pace and Legal Status of Titanium Dioxide as Food Additive

	Dependent variable: antonelli_quali/pole_quali
tio2	−0.003 (0.006)
Constant	1.014*** (0.004)
Observations	30
R2	0.007
Adjusted R2	−0.029
Residual Std. Error	0.016 (df = 28)
F Statistic	0.195 (df = 1; 28)
Note:	*p<0.1; **p<0.05; ***p<0.01

Counter to our expectations, Antonelli's qualifying pace did not have any statistically significant correlation with the legal status of titanium dioxide as a food additive. We then normalized this qualifying pace data against the average for Mercedes (i.e. `(antonelli_quali / pole_quali) - (((antonelli_quali / pole_quali) + (russell_quali / pole_quali)) / 2)`).

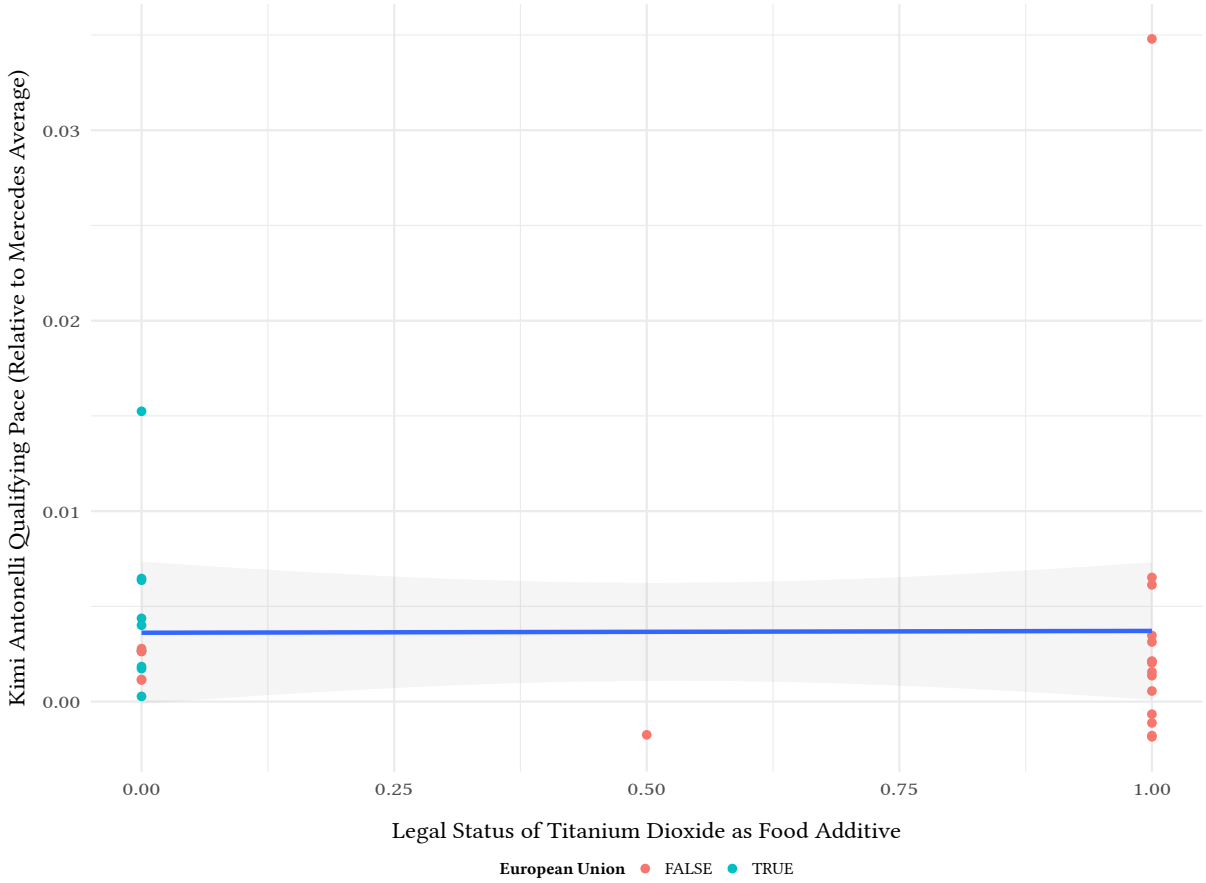

Figure 4: Kimi Antonelli Qualifying Pace (Relative to Mercedes Average) and Legal Status of Titanium Dioxide as Food Additive

	Dependent variable: antonelli_quali_norm
tio2	0.0001 (0.003)
Constant	0.004* (0.002)
Observations	30
R2	0.00005
Adjusted R2	−0.036
Residual Std. Error	0.007 (df = 28)
F Statistic	0.001 (df = 1; 28)
Note:	*p<0.1; **p<0.05; ***p<0.01

After normalization, we still did not find any statistically significant relationship between Antonelli's qualifying pace and the legal status of titanium dioxide as a food additive. These conclusions suggested to us that, if there was any causal relationship between Kimi Antonelli's performance during Formula One sessions and whether titanium dioxide was legally allowed as a food additive, it was restricted to race pace only and not qualifying pace.

Recognizing the fact that Kimi Antonelli generally did not perform particularly well at the European races during the 2025 season compared to his overall performance throughout the year, and the fact that the European Union, which includes many of the jurisdictions the European races were held in, has a blanket ban on the use of titanium dioxide as a food additive, we considered being in the European Union a confounding variable in the relationship between Antonelli's F1 performance and titanium dioxide's legal status.

	Dependent variable: antonelli	*Dependent variable:* tio2
is_european_union	8.920*** (2.069)	−0.705*** (0.162)
Constant	7.455*** (1.069)	0.705*** (0.084)
Observations	30	30
R2	0.399	0.402
Adjusted R2	0.377	0.381
Residual Std. Error	5.012 (df = 28)	0.393 (df = 28)
F Statistic	18.585*** (df = 1; 28)	18.833*** (df = 1; 28)
Note:	*p<0.1; **p<0.05; ***p<0.01	

Conducting linear model fitting for both of these variables against membership of the EU, we found that both Antonelli's performance and the legal status of titanium dioxide had a statistically significant relationship with EU membership. It is possible, therefore, that there are other causes that could explain Antonelli's relative poor performance in Europe during the middle part of the 2025 season that are not related to titanium dioxide not being allowed as a food additive, including specific circuit characteristics and Antonelli's own ongoing development as a Formula One driver.

Conclusion

Using data on finishing positions and qualifying lap times during the 2025 Formula One World Championship as provided by the FIA and conducting linear model regressions against the legal status of titanium dioxide as a food additive, we found that Antonelli finished in statistically higher positions at races taking place in jurisdictions where the

use of titanium dioxide as a food additive was legally allowed, both before and after normalization for average constructor performance across circuits. We did not, however, find any statistically significant relationship between Antonelli's qualifying pace and the legal status of titanium dioxide regardless of normalization. If culinary use of titanium dioxide was causally linked to Antonelli's racing performance, it is only race pace and not qualifying pace that is affected. In addition, it is possible that other factors may be able to explain Antonelli's poor performance in Europe during the 2025 season that are unrelated to titanium dioxide's legal status, due to the confounding effect of the EU's general ban on the use of titanium dioxide as an additive.

Recommendations

Despite the uncertainty surrounding the causality between the use of titanium dioxide as a food additive and Antonelli's racing performance in F1, due to the non-zero possibility of Oscar Piastri, a highly talented driver racing for McLaren Mastercard F1 Team, making a miraculous comeback in the remainder of the 2026 season and winning his first WDC against all odds, it is our recommendation that Mercedes-AMG Petronas Formula One Team supply Kimi Antonelli with a titanium dioxide-heavy diet if they wish to secure the 2026 World Drivers' Championship for Antonelli.

Further research on this topic should consider expanding the dataset to include drivers from other teams as well and possibly conducting a controlled dietary experiment, which would result in more credible results and recommendations to drivers and constructors on how to best adjust for titanium dioxide availability across different races. It may also be beneficial for the FIA to look into banning titanium dioxide intake for drivers as part of the new set of regulations introduced in 2026 in order to ensure fairness and improve racing, if there are further studies that justify doing so.