Race and the Probability of Being Unarmed When Shot and Killed by the Police

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1 Introduction

As of December 5, 2022, the Washington Post has logged 8,004 fatal police shootings since 2015 [1]. In 2015, they logged 994. The Post has found that the rate at which blacks are shot and killed is 2.3 times higher than Hispanics, 2.5 times higher than whites, and 6.7 times higher than "Other" racial groups [1]. Black individuals also made up 40 percent of those who were killed while unarmed [1].

Many researchers have tried to see whether the race of the individual impacts the probability that they will be shot and killed by the police. Some have found strong bias against black individuals [2], [3]. Others have found no evidence of racial bias in regards to police use of lethal force [4], [5].

In regards to being unarmed while shot and killed by the police, the literature suggests that there exists a degree of racial bias that cannot be explained by other factors. For example, researcher Cody Ross conducted a county-level study to estimated the difference in the probability of being black, unarmed, and shot by police compared to the probability of being White, unarmed, and

shot by police. He found "significant" bias in unarmed police shootings; black individuals were 3.49 times more likely to be shot while unarmed compared to White individuals [6]. A follow-up study by Ross, Winterhalder, and McElrath found that, "there is strong and statistically reliable evidence of anti-black racial disparities in the killing of unarmed Americans by police in 2015–2016," even after correcting for criminal behavior [7]. Most relevant to this particular analysis is a study by Nix et al. which analyzed the same data set and found that "Black civilians were more than twice as likely as White civilians to have been unarmed" when they were shot and killed by the police [8].

The plausible mechanisms whereby a black subject is more likely to be shot and killed can present itself in many forms. For example, officers who possess some degree of racial bias, either consciously or sub-consciously, may be more likely to assume that a black subject who they encounter on the street has a weapon their person during the encounter.

This study does *not* seek out to test whether there exists a racial bias among police officers in their decision to shoot and kill a subject given their armed status. Rather, I seek to see if race effects the probability, *conditional on being shot and killed by the police*, of being unarmed. This is different than the question of whether unarmed black individuals are more likely to be killed compared to unarmed non-black individuals.

My results imply that black subjects were 61 percent more likely to be unarmed conditional on being shot and killed by the police compared to non-black individuals, even after controlling for variables that might affect that probability. When I restrict the sample to only black, Hispanic, and white subjects, I find that a black subject is 2.1 times as likely to be unarmed conditional on being shot and killed by the police ($p < 0.01$), while a Hispanic subject is 1.8 times as likely, but this result is only statistically significant at the 10% level.

I also find significant age and mental health interaction effects for the risk of being unarmed conditional on being shot and killed for black subjects.

1.1 Summary Data

In this section, I present data that offers a short summary of the nature of police shootings across the United States in 2015. First, I present summary statistics for the variables included in the data set. As can be seen in Table 1, the average age of a subject who was a shot and killed by the police was 36.69 years old, 95.8% were male, 9.6% were unarmed, 26.0% were black, 27.9% were fleeing at the time of the killing, 7.5% of cases involved body camera footage, and 26.2% had signs of mental illness.

Table 1: Summary Statistics of Select Variables

Variable	N	Mean	St. Dev.
age	-	36.689	13.021
male	952	0.958	0.201
unarmed	95	0.096	0.294
black	258	0.260	0.439
subject fled	277	0.279	0.449
body camera	75	0.075	0.264
mental illness	260	0.262	0.440

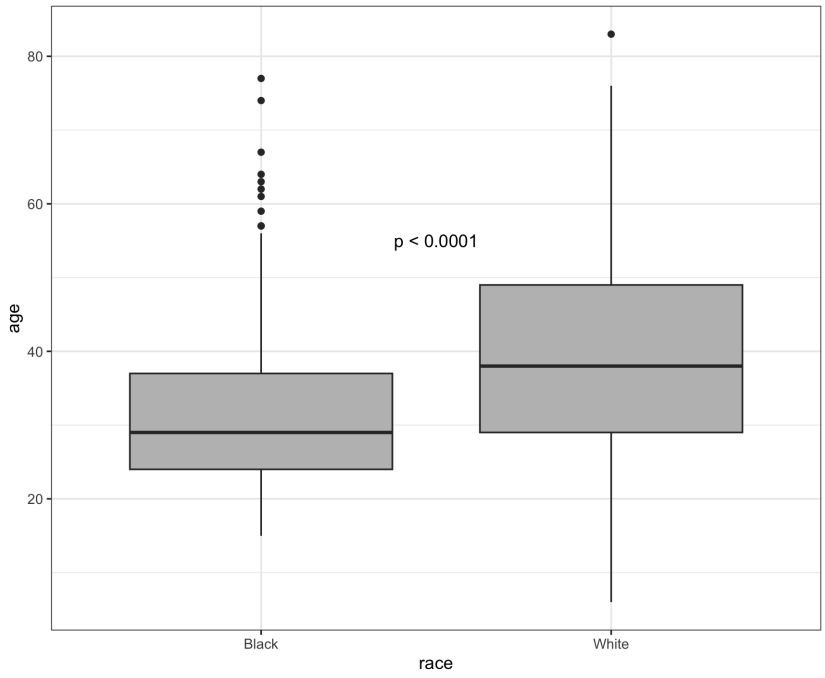
Second, I present a correlation matrix using select variables. I use a Spearman's correlation coefficient because there are no continuous variables present in the matrix, only dummy variables.

Table 2: Correlation Matrix of Select Variables

	gender	armed	race	flee	body camera	mental illness
gender	–	0.017	0.010	-0.014	0.003	-0.068
unarmed	0.017	–	0.104	0.088	0.063	-0.030
race	0.010	0.104	–	0.067	0.031	-0.138
flee	-0.014	0.088	0.067	–	-0.016	-0.186
body camera	0.003	0.063	0.031	-0.016	–	0.029
mental illness	-0.068	-0.030	-0.138	-0.186	0.029	–

Looking more into racial differences in age, I find that black subjects shot and killed by the police tend to be much younger than white subjects shot and killed by the police. Figure 1 shows a two box plot distributions. The mean age of a black subject is 31.99 years, while the mean age of a white subject is 39.66 years. This difference in statistically significant (t = -8.32; $p < 0.001$).

Figure 1: Mean Age of Black and White subjects



2 Methods

I use the Washington Post Fatal Force database to analyze the effect of race on being unarmed while shot and killed by the police [1]. I analyze data for one year, 2015, where 994 individuals were shot an killed by the police, of which 95 (9.6%) were unarmed, as mentioned previously.

I use four control variables: "age" (how old the individual was at the time of the shooting), "flee" (whether the individual fled from the police before the shooting took place or not), "body camera" (whether there is body camera footage of the shooting or not), and "mental illness" (whether the individual who was shot and killed was mentally ill or not).

I create dummies for each of these variables, except for age, using the "fastDummies" package in R:

Unarmed

- 1 if the subject was unarmed, 0 if not

Flee

- 1 if the subject was fleeing, 0 if not

Body camera

- 1 if the incident involved body camera footage, 0 if not

Mental illness

- 1 if the subject showed signs of mental illness, 0 if not

Using R statistical software, I use a logistic regression model to estimate the odds of a black individual being unarmed if shot and killed by the police compared to a non-black individual, controlling for factors that might affect

that relationship. The model is shown by the equation below where β_0 is the constant and β_k where $k = (1, 2, ..., 5)$ denote the coefficients for each variable. The equation is shown as follows:

$$ln\left(\frac{P(unarmed = 1)}{1 - P(unarmed = 1)}\right) = \beta_0 + \beta_1 black + \beta_2 age + \beta_3 flee + \beta_4 bodycamera + \beta_5 mentalillness$$

I then perform another regression to test if there are any interactions effects between control variables that might be of interest to the topic of this paper. After that, I test whether, relative to *whites*, black and Hispanic subjects are more likely to be unarmed if shot and killed. To do this, I filter out the cases involving Asian, Native American, and "Other" subjects, so that the cases only involve black, Hispanic, and white subjects. Since these subjects make up the vast majority of subjects, 93.9% of cases still remain. I use the dummy_cols() function in the "fastDummies" package in R to make these dummy variables.

3 Results

The results of the analysis are shown in Table 3. In the bivariate model (Column (1)), a black individual is 105 percent more likely than a non-black individual to be unarmed conditional on being shot and killed by the police (OR = 2.05, $p < 0.01$). Column (2) controls for "age" and "flee," and finds that a black individual is 65 percent more likely than a non-black individual to be unarmed conditional on being shot and killed by the police (OR = 1.65, $p < 0.05$). Finally, column (3), the preferred model, implies that a black individual is 61 percent more likely than a non-black individual to be unarmed conditional on being shot and killed by the police (OR = 1.61, $p < 0.05$). In addition, Figure 2 shows the odds ratios for each variable and their respective confidence intervals. Interestingly, fatal shootings with subjects that were unarmed were

96.4% ($p < 0.05$) more likely to have body camera footage than those where the subject possessed a weapon. This is an interesting result because incidents where subjects are unarmed tend to garner more attention from the media and the public than those with armed subjects. The same results are portrayed visually in a forest plot (Figure 2).

Table 3: The Effect of Race on Being Unarmed if Shot and Killed by the Police

	Dependent variable:		
	unarmed		
	(1)	(2)	(3)
const.	-2.478^{***}	-1.528^{***}	-1.562^{***}
	(0.138)	(0.390)	(0.400)
black	0.722^{***}	0.501^{**}	0.476^{**}
	(0.223)	(0.232)	(0.235)
age		-0.030^{***}	-0.031^{***}
		(0.010)	(0.010)
flee		0.480^{**}	0.481^{**}
		(0.228)	(0.232)
body camera			0.675^{**}
			(0.344)
mental illness			-0.054
			(0.275)
Observations	994	986	986
Log Likelihood	-308.387	-297.636	-295.905
Akaike Inf. Crit.	620.774	603.271	603.810
Note:			*p<0.1; **p<0.05; ***p<0.01

Figure 2: Forest Plot of Odds Ratios and Confidence Intervals for Variables in Table 2, Model (3)

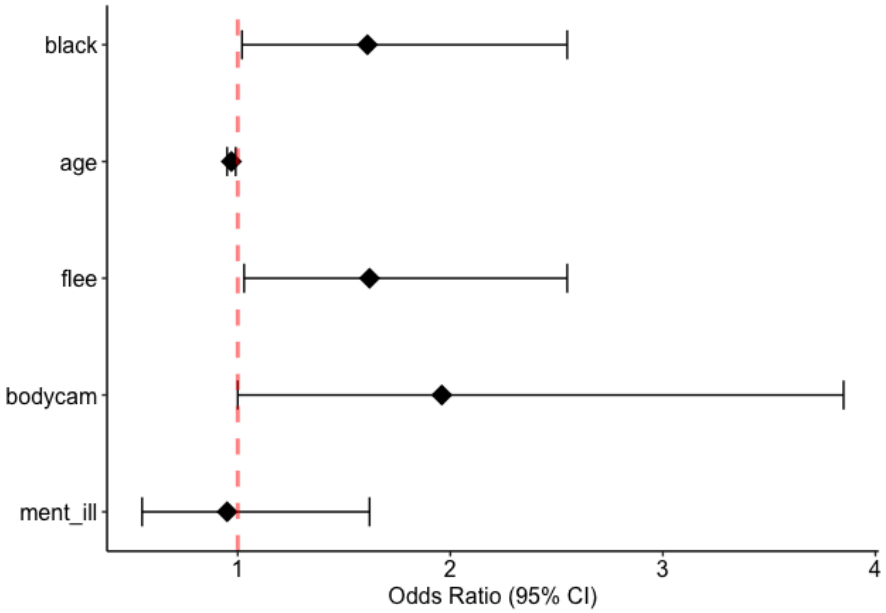


Table 4 presents results from a separate regression, testing to see how interaction effects can help explain variance in unarmed police shootings. In it, I include an interaction effect between whether the individual is black and the presence of mental illness, if they were fleeing or not, their age, and whether the incident had body camera footage. There is a statistically significant mental illness interaction in the model. I also find a statistically significant age interaction as well, suggesting that the there are racial differences in the probability of being unarmed if killed by age group.

Table 4: The Effect of Race on Being Unarmed if Shot and Killed by the Police, adding Interaction Terms

	Dependent variable:		
	unarmed		
	(1)	(2)	(3)
const.	-2.478^{***}	-1.562^{***}	-0.814^{*}
	(0.138)	(0.400)	(0.477)
black	0.722^{***}	0.476^{**}	-1.527^{**}
	(0.223)	(0.235)	(0.768)
age		-0.031^{***}	-0.049^{***}
		(0.010)	(0.013)
flee		0.481^{**}	0.315
		(0.232)	(0.301)
body camera		0.675^{**}	1.010^{**}
		(0.344)	(0.430)
mental illness		-0.054	-0.540
		(0.275)	(0.357)
black × mental illness			1.397^{**}
			(0.574)
black × age			0.052^{**}
			(0.021)
black × flee			0.467
			(0.484)
black × body camera			-0.781
			(0.728)
Observations	994	986	986
Log Likelihood	-308.387	-295.905	-289.185
Akaike Inf. Crit.	620.774	603.810	598.370
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 5 shows the probability that a given subject is unarmed assuming they are the average age in the data set (36.69 years) and all other dummy variables (except for mental illness) are set to 0. As can be observed the probability that a black subject of average age who has mental health comorbidities is unarmed conditional on being shot and killed by the police is 14.1%. On the other hand, the probability for a non-black subject in the same circumstances is 5.1%

Table 5: The Probability of Being Unarmed by Race and Mental Health Comorbidity Status

Race	Mental Health Comorbidities	P(unarmed)
Black	Yes	0.141
Non-Black	Yes	0.051

As mentioned previously, there is a statistically significant ($p < 0.05$) age interaction for black subjects in Table 4. This implies that there exist racial differences in the probabilities that a subject at a given age who is shot and killed is unarmed at the time of the shooting.

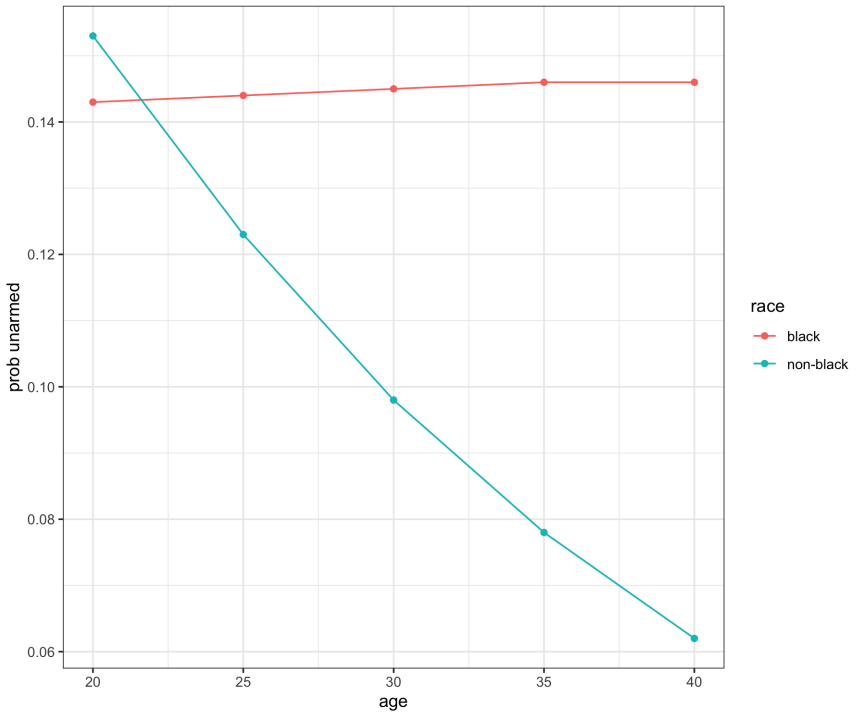
To demonstrate this more simplistically, I use an equation that only includes race (1 = black, 0 = non-black), age, and the interaction term between the two. The equation is:

$$ln\left(\frac{P(unarmed = 1)}{1 - P(unarmed = 1)}\right) = \beta_0 + \beta_1 black + \beta_2 age + \beta_3 black * age$$

The following figure (Figure 3) arises from this model. In the figure, P(unarmed) was calculated for ages 20, 25, 30, 35, and 40. As can be seen, the proportion of black subjects (orange line) who are unarmed when shot and killed by the police remains relatively flat at each age, going from roughly 14.3% at age 25 to 14.6% at age 40. However, for non-black subjects (teal line) the proportion who are unarmed substantially decreases with age, going from roughly 15.3% at age

20 to just 6.2% by age 40. Thus, for non-black subjects, the probability of being unarmed, conditional on being killed by the police, substantially decreases with age. The same cannot be said for black subjects, given the fact that proportions remain almost completely flat across the age distribution.

Figure 3: Probability that a Subject of a Given Age is Unarmed Conditional on Being Shot and Killed by the Police, by Race



Next, I test to see whether comparing black and Hispanic subjects to white subjects yields different results than only comparing black subjects to non-black subjects, or in the case of Hispanic subjects, Hispanic subjects to non-Hispanic subjects. I exclude Asian and Native American subjects because zero Asian subjects were unarmed when they were shot and killed by the police and only one Native American subject was. By contrast, 38 black subjects, 31 white subjects, and 21 Hispanic subjects were unarmed when they were killed by the

police in 2015 (Table 6). As can be seen, however, the proportions for blacks and Hispanics are significantly different than for whites ($p < 0.001$ and $p < 0.05$, respectively).

Table 6: Armed Status of subjects by Race

Race	Unarmed	Armed	% Unarmed
Asian	0	17	-
Black	38	220	14.7%
Hispanic	21	153	12.0%
Native American	1	9	10.0%
White	31	471	6.2%

Table 7 shows the results of results comparing minority subjects to white subjects, seeing if they were more likely to be unarmed conditional on being shot and killed by the police. I find that, even after controlling for the factors in previous analyses above, both Hispanic and black subjects are more likely to be unarmed when shot and killed by the police compared to white subjects. In the un-adjusted model, black subjects are 2.6 times as likely to be unarmed compared to white subjects ($p < 0.01$), while Hispanic subjects are roughly 2.1 times as likely ($p < 0.05$). However, in the adjusted model, black subjects are roughly 2.1 times as likely to be unarmed compared to white subjects ($p < 0.01$), while Hispanic subjects are roughly 81% more likely, but this difference is only statistically significant at the 10% level ($p = 0.05$).

Table 7: The Effect of Race on Being Unarmed while Shot and Killed by the Police, Restricting the Sample to Blacks, Hispanics, and Whites

	Dependent variable:	
	unarmed	
	(1)	(2)
const.	-2.721^{***}	-1.956^{***}
	(0.185)	(0.449)
black	0.965^{***}	0.724^{***}
	(0.255)	(0.270)
Hispanic	0.735^{**}	0.593^{*}
	(0.298)	(0.304)
age		-0.025^{**}
		(0.011)
mental illness		-0.069
		(0.289)
flee		0.467^{*}
		(0.239)
body camera		0.582
		(0.356)
Observations	934	930
Log Likelihood	-288.266	-279.147
Akaike Inf. Crit.	582.533	572.295
Note:	*p<0.1; **p<0.05; ***p<0.01	

4 Conclusion

In conclusion, I find that black individuals who were killed by the police in 2015 were significantly more likely to be unarmed compared to non-black individuals. The results may suggest that police are more willing to shoot and kill black subjects who are unarmed compared to non-black subjects, however, that

implication should be taken with a small amount of weight given the complexity of police decision making and the factors that could not be accounted for in this analysis. I also find that Hispanic subjects are more likely to be unarmed conditional on being shot and killed by the police, but this result is more fragile and carries the same limitations as the results found for black subjects. The variables in the regression model can explain a very small proportion of the variance in the dependent variable, being unarmed, so results should be taken with caution. More research is needed to adequately investigate the nature of police shootings of unarmed civilians in the United States.

References

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