

Suicide Possibility and Occupation: Evidence from the U.S. CDC Report

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Abstract

In recent years, the factors that influence suicide risk have been extensively investigated, but there is a dearth of studies on the effect of occupational choice on suicide rates. This paper aims to examine the relationship between the occupations and suicide rates in the U.S. using mortality data from the National Vital Statistics System of CDC and occupational data from US Census data. We use the Logit model to control the individual and occupational-related factors to investigate which occupation has higher suicide rates. The empirical results show that there exists positive correlation between possibilities of suicide and occupations with higher internal pressure and negative correlation if employees in occupations face relative lower stress. These findings match with our initial hypothesis and can provide support for making plans to reduce suicide rate in the U.S.

1 Introduction

Not only in recent years but also decades ago, suicide was a major public health concern. There has been a wide variety of research on suicide rates in social science. Previous research has described some potential factors that may influence the suicide rate, but empirical tests are not sufficient. In this paper, we attempt to explore the correlation between professions and suicide rates when controlling individual and professional characteristics. In detail, the correlation reflects the pressure level because other characteristics of professions are potentially controlled. Considering this, this paper mainly focuses on whether different professions will generate different levels of pressure which are potentially related to the suicide rates.

It is well known that population growth has traditionally been considered the positive factor in stimulating economic growth. More people in a country means that the country has a large labor force. It also indicates more productive manpower and a larger size of the domestic market. However, the rapidly increasing in suicide rate among people of working age threatens the country's economic growth. According to the studies by the Centers for Disease Control and Prevention (CDC), suicide among the U.S. working-age population is increasing by 40% in less than two decades. Nearly 38000 persons of working age died by suicide in 2017. So, in order to promote sustainable economic development, it's necessary to put effort into decreasing the suicide rate, especially among people of working age. The factors that cause suicide are the foundations for both government and firms to prevent suicide. Since most adults spend a lot of time working, the choice of professions can be considered one of the important factors to analyze the suicide rate. Therefore, to understand the causality between suicide rate and professions, it is crucial to quantify professions and control variables that can influence both the dependent variable: suicide rate, and the research variable: profession.

Logistic regression is chosen in this paper to examine the correlation between suicide rate and potential factors. The first part is to use a logit model that includes personal factors as controlled variables and different occupations as the dependent variable. The personal factors are age, gender, race, years of education, and marital status. The second part is to use the logit model to explain how the nature of the job influences the suicide rate. We estimate the probability of suicide, given the wage level and working hours. The wage level and working hours are the occupation-related variables that need to be controlled to show the nature of the job.

From the empirical results of logit models, age, gender, marital status, and race all have a significant impact on the possibilities of suicide. After controlling individual characteristics, occupations still can be considered a significant factor that influences the probability of suicide. After controlling both individual characteristics and occupation-related variables, protective service and military jobs and some jobs that required communication have significant changes in the probability of suicide, which indicates the different internal pressure levels influence suicide.

The rest of the paper is organized as follows. Section 2 describes what has been done in previous studies. These provide background information and support to our research. Section 3 describes the data and main descriptive statistics. Section 4 presents the result. Finally, section 5 presents conclusions.

2 Literature Review

Regarding the relationship between suicide risk and occupations, several studies have shown that some occupations such as physicians and veterinarians have higher suicide rates than other professions (Platt et al., 2010; Roberts et al., 2013). These occupations are considered to have greater access to the means of committing suicide. For instance, physicians can use medical drugs and law enforcement officers can access firearms to commit suicide (Roberts et al., 2013). Additionally, other work-related features can influence suicide rates. First, low-skilled occupations like construction and extraction have a higher rate of suicide because of a lack of stable employment and income (McIntosh et al., 2016; Windsor-Shellard and Gunnell, 2019). Low-skilled jobs which have low barriers to entry, compared with other occupations, do not require an advanced degree (Maxwell, 2006). Second, researchers Phillips and Hempstead (2017) claimed that people with at least a college degree had the lowest suicide rates in the U.S. from 2004 to 2014 since people with less education are likely to have interpersonal relationship problems and financial burdens. Third, long working hours per week and job pressure were positively related to the moderate and severe suicidal ideation. (Choi, 2018; Lee et al., 2020). However, since some studies have adopted the multiple regression analysis that included the individual characteristics to analyze the work-related factors, the confounding variable problem might arise.

In addition to the work-related factors, demographic characteristics also can influence suicide rates. There are several factors usually considered: age, sex, marital status, and race. Many studies have shown that the suicide rates in-

crease with age and people aged 65 and older had a higher risk of suicide than other age groups in the United States (Mościcki, 2001; Cheong et al., 2012). In terms of the potential reasons for suicide deaths among older people, Iribarren and other scholars (2000) have claimed that physical diseases, solitary life, and reduced income will force older people to commit suicide. Besides, when comparing the suicide rates between males and females, the male suicide rates are four times that of women since females are more willing to seek help when they are depressed (Murphy, 1998; Kposowa, 2000). Marital status also has a significant impact on the suicide rates. Higher risks of suicide are correlated with divorced and separated people. When combining marital status and sex together, it is found that divorced males are more than twice as likely to commit suicide than married males while there is not a statistically significant difference in the suicide rate of females (Kposowa, 2000). Apart from the three factors mentioned above, the suicide rates have the characteristics of racial distinctions. Whites have a higher suicide rate than blacks while the gap is narrowing (Kubrin and Wadsworth, 2009).

Given the fact that 96.6% of the construction and extraction workforce are males and the suicide risk of males is higher than females, it is hard to know whether the profession itself or the combined effect with gender leads to the high suicide rates. Therefore, controlling for the demographic variables is essential in studying the high-risk occupations.

Although scholars investigate various factors influencing the suicide rate, there are few studies on suicide from the point of high-risk occupation. Unlike previous studies that usually focus on a specific occupation and limited sample size, the present study controls the confounding effects to better examine the relationship between the suicide rates and different industries from the national level. Even though Steven Stack has estimated the occupational suicide risk with the U.S. Public Health Service national data and controlled for the demographic covariates in 2002, the suicide risk can change over time and the experiment result needs to be re-examined. Another notable study comes from researcher Choi (2018) who has conducted longitudinal research about the relationship between chronic psychosocial work stressors and suicidal ideation of U.S. workers. He found that chronic psychosocial work stressors like job strain and long work can influence suicide ideation after controlling the confounding factors. This proves that occupations are closely related to the suicide rates. Compared with Choi's research, this paper focuses on completed suicide since people who have suicidal ideation do not mean they will end up committing suicide. Moreover, this paper provides a basis for effectively developing suicide

prevention and intervention in different industries.

3 Empirical Strategy

3.1 Data Description

In this research, we use the mortality data from the National Vital Statistics System of CDC. It records data on all deaths in the United States in the given year, including time and manner of death, basic personal information, occupation and industry information, etc. Specifically, we use data from 2020, with a total sample size of 3,104,680. Since this data, as officially recorded data, includes all individual cases except for those not identified, it is unlikely to have sampling-related problems. In addition to our focus on the manner of death (whether it was a suicide) and occupation, we also filter out some potentially relevant personal information, such as age, gender, marital status, ethnicity, and educational attainment. In this case, we convert the highest education variable into a continuous variable specifying years of education for fitting purposes.

Specifically, for our variable of interest, manner of death, there are 46,184 suicide cases in the sample, implying an overall US suicide rate of 1.49% in 2020. Taking occupational variables into consideration, as can be seen in Figure 3, a subset of occupations have much higher suicide rates than the average, such as computer and math, military, and construction-related occupations. Thus, it is reasonable to assume that occupational choices have an impact on people’s suicide rates.

Summary		Summary	
Manner of death		Education	
Accident	81862	8th grade or less	91811
Suicide	18719	9 -12th grade, no diploma	100825
Homicide	10955	high school graduate or GED completed	450712
Pending Investigation	1954	some college credit, but no degree	132293
Could not determine	3982	Associate degree	70525
Self-inflicted	0	Bachelor's degree	112607
Natural	931103	Master's degree	47308
		Doctorate or professional degree	18221
		Unknown	24273
Summary		Summary	
Marital Status		Race	
Single	160844	White	863600
Married	375265	Black	150542
Widowed	314683	American Indian	8476
Divorced	187327	Asian or Pacific Islander	25957
Unkonwn	10456		
Summary			
Sex			
Female	487295		
Male	561280		
Summary		Summary	
Management	77020	Education, Training & Library	36725
Business&Financial Operation	22253	Arts, Design, Entertainment, Sports & Media	13821
Computer & Mathematical	7163	Healthcare Parctitioners & Technical	34339
Architecture & Engineering	19233	Healthcare support	14413
Life ,Physical & Social Science	5393	Protective service	16572
Community & Social Services	11572	Food preparation & serving related	27553
Legal Occupations	5301	Building & grounds cleaning & maintenance	28306
Summary		Summary	
Personal care & service	19700	Transportation & material moving	66403
Sales & related	66493	Military	11046
Office & administrative support	77766	Other—misc (exc housewife)	72476
Farming, fishing, & forestry	6517	Other—housewife	110361
Construction & extraction	65125		
Installation, maintenance, & repair	32852		
Production	70078		

Figure 1: Data Summary

In addition, we intend to include other occupation-related data, such as wages and working hours. The occupational classifications in the mortality data come with standardized codes, which can be directly matched to that in the US Census data. We can extract the average number of occupational wages and hours worked directly from the Census data and include them in our data-set.

Occupation Title	Total Employment	Income		Working Hours	
		Hourly Wage Mean	Annual Wage Mean	Total at Work	Full Time
Management Occupations	8,909,910	59.31	123,370	38.7	42.1
Business and Financial Operations Occupations	9,053,790	39.72	82,610	40.3	42.6
Computer and Mathematical Occupations	4,654,750	48.01	99,860	41.9	43.7
Architecture and Engineering Occupations	2,436,520	44.10	91,740	39.0	41.8
Life, Physical, and Social Science Occupations	1,273,640	38.81	80,730	34.8	41.1
Community and Social Service Occupations	2,239,680	25.94	53,960	37.2	41.4
Legal Occupations	1,178,140	54.38	113,100	37.5	42.5
Educational Instruction and Library Occupations	8,191,930	29.88	62,140	36.9	40.5
Arts, Design, Entertainment, Sports, and Media Occupations	1,815,290	31.78	66,100	40.5	42.1
Healthcare Practitioners and Technical Occupations	8,787,730	43.80	91,100	40.0	41.5
Healthcare Support Occupations	6,603,680	16.02	33,330	41.4	42.6
Protective Service Occupations	3,385,030	25.68	53,420	39.6	42.5
Food Preparation and Serving Related Occupations	11,201,480	14.16	29,450	40.7	42.3
Building and Grounds Cleaning and Maintenance Occupations	4,108,810	16.23	33,750	38.8	42.7
Personal Care and Service Occupations	2,566,440	16.17	33,620	40.6	43.0
Sales and Related Occupations	13,256,290	22.15	46,080	42.0	43.7
Office and Administrative Support Occupations	18,299,380	20.88	43,430	43.4	44.7
Farming, Fishing, and Forestry Occupations	452,490	16.70	34,730	40.8	42.7
Construction and Extraction Occupations	5,848,950	26.87	55,900	37.1	42.1
Installation, Maintenance, and Repair Occupations	5,574,410	25.66	53,380	39.5	42.9
Production Occupations	8,408,030	20.71	43,070	40.3	43.6
Transportation and Material Moving Occupations	12,639,920	19.88	41,340	38.2	41.6

Figure 2: Wage and Working Hours by Occupation

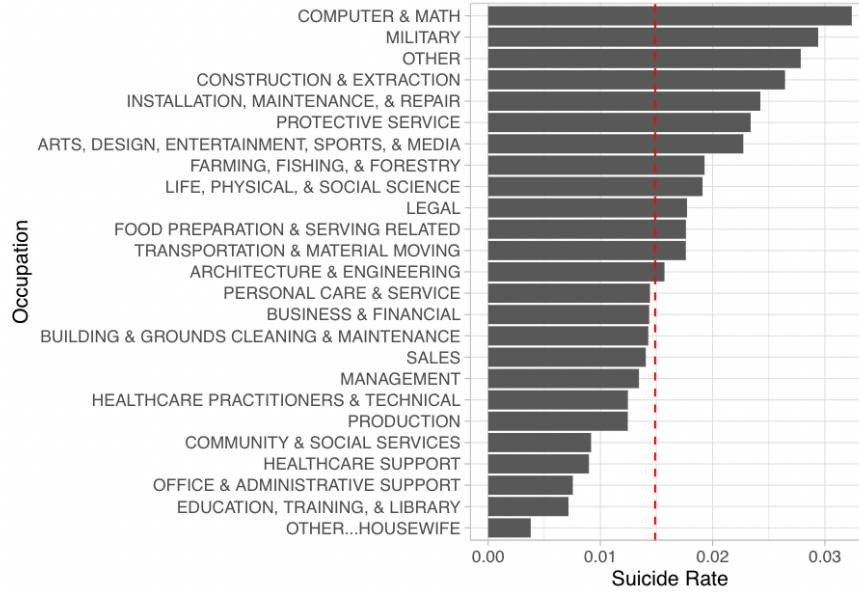


Figure 3: Suicide Rate in Different Occupations

3.2 Model and Variables

Our empirical tests can be divided into three main parts. In order to identify the effect of occupational choice on suicide rates, we first need to explore the individual factors that determine suicide rates and bring them into the regressions that follow. High suicide rates in some occupations may simply be due to the fact that there are more men (or women) in that occupation, under the premise that men (or women) are more likely to choose suicide. The model can be denoted by the following formula:

$$Pr(suicide = 1) = \alpha + X_1\beta_1 + \epsilon$$

Since the dependent variable suicide is categorical, we use logistic regression to find the effect of these personal factors on their choice to commit suicide. The logit model not only provides a measure of how appropriate a predictor(coefficient size)is, but also shows direction of association (positive or negative). Specifically, we hypothesise that the personal factors that can determine suicide rates are age, as the probability of dying due to other factors increases with age and may differ between age groups in terms of mindset; gender, as males and females have different ways of thinking and may be subject to structurally

different stressors in their lives; and race, as racial identity is likely to influence how an individual is treated in society and different communities have various safety and health environments; race is categorized into three groups: White, Black and Asian; years of education, as people with different levels of education may have different perceptions of death; and marital status, as being in different stages of an intimate relationship may have different psychological impacts. We divide the marital status into four coding categories: Married, Single, Widowed, and Unknown.

Thereafter, using a logistic regression with occupation as the factor variable and including the control variables used above, we will identify whether an individual's choice of occupation changes his or her probability of suicide. At this stage, we will include 25 occupation variables.

Finally, we include variables directly related to occupation, wage and working hours, in the regression and from this we identify the effect of the implicit characteristics of occupation or the nature of the job on the suicide rate, i.e. which occupation is subject to a higher suicide rate given the desired wage and working hours. We will set engineering as the baseline and compare it with community and social services, education, food preparation, serving, office administration, protective service and military, and healthcare-related occupation. The result will show the impact of working content on the probability of suicide rate, for example, whether or not working in a healthcare facility and witnessing death all year round increases people's suicide rates.

4 Result

For individual factors, as shown in Figure 4, age, gender, marital status and race all have an impact on suicide possibilities. The older you are, the less likely you are to commit suicide and, as older people have significantly higher probability of dying from other causes. However, this result is different from the previous studies that age is positively related to the suicide rate (Mościcki, 2001; Cheong et al., 2012). The different data selection might lead to the different result. Previous studies adopt the time periods while we only focus on the data in 2020. Additionally, the males are more likely to commit suicide than females, possibly due to differences in the way males think, or due to the different social expectations undertaken. For marital status, being single and being in a marriage have a lower likelihood of suicide compared to divorcees, possibly due to the companionship in an intimate relationship. In terms of race, Blacks and American Indians are less likely to commit suicide than Whites, and

Asians are more likely to commit suicide. More years of education are associated with a higher likelihood of suicide, possibly due to the relatively higher pressure of competition and higher expectations of self.

	Estimate	Std. Error	z value	Pr(> z)
(Intercept)	-2.793	0.026	-107.765	0.000
Age	-0.053	0.000	-210.036	0.000
sex	0.976	0.012	79.461	0.000
mariM	-0.265	0.014	-19.250	0.000
mariS	-0.088	0.015	-5.999	0.000
mariU	0.013	0.077	0.168	0.867
mariW	-1.577	0.024	-66.338	0.000
race2	-1.145	0.018	-62.904	0.000
race3	-0.062	0.040	-1.559	0.119
race4	0.105	0.027	3.842	0.000
educ	0.125	0.002	80.561	0.000

Figure 4: Result for the Individual Characteristics on Suicide

After controlling the personal factors, we include the career choice factor in the model and compare it with the original model. The suicide rates for architecture and engineering are close to the average suicide rate, so we use them as the baseline and omit them in the regression. In the original model, we find that computer and mathematical occupations, construction-related occupations, farming and fishing, and the military have significantly higher probabilities of suicide than architecture and engineering, and that community service, education, office administration, healthcare-related occupations, and housewife are significantly less likely to commit suicide than architecture and engineering. After the inclusion of control variables, several odds ratios, such as farming and fishing, transportation and material moving, change significantly from higher to lower than engineering, suggesting that the high suicide rates in these industries are mainly due to the higher proportion of males in these industries. For healthcare-related occupations, the probability changes from lower to higher, which are more likely to cause suicide i.e. excluding the fact that there are more women in the industry. It is particularly noteworthy that after controlling the personal characteristics, the probability of suicide still stands out in several occupations, such as military, protective service, and computer and math, which we believe may be related to trauma and stress.

	Model 1	Odds Ratio 1	Model 2	Odds Ratio 2
Intercept	-4.138***	0.016	-2.009***	0.134
Age			-0.056***	0.945
Sex			0.832***	2.297
mariM			-0.220***	0.803
mariS			-0.043**	0.958
mariU			-0.063	0.939
mariW			-1.628***	0.196
race2			-1.153***	0.316
race3			-0.033	0.968
race4			0.153***	1.165
educ			0.088***	1.092
ARTS.DESIGN.MEDIA	0.377***	1.457	0.149**	1.160
BUILDING.CLEANING	-0.098*	0.907	-0.108*	0.897
BUSINESS.FINANCIAL	-0.092*	0.912	-0.016	0.984
COMMUNITY.SOCIAL.SERVICES	-0.544***	0.580	-0.409***	0.664
COMPUTER.MATH	0.741***	2.098	0.270***	1.310
CONSTRUCTION.EXTRACTION	0.532***	1.702	0.085*	1.089
EDUCATION.TRAINING.LIBRARY	-0.795***	0.452	-0.454***	0.635
FARMING.FISHING.FORESTRY	0.208**	1.232	0.034	1.034
FOOD.PREPARATION.SERVING	0.117**	1.124	-0.233***	0.792
HEALTHCARE.PRACTITIONERS	-0.236***	0.790	0.019	1.020
HEALTHCARE.SUPPORT	-0.566***	0.568	-0.066	0.936
INSTALLATION.MAINTENANCE	0.443***	1.557	0.188***	1.207
LEGAL	0.123	1.130	-0.190**	0.827
LIFE.PHYSICAL.SOCIAL	0.199**	1.220	0.053	1.055
MANAGEMENT	-0.158***	0.854	-0.047	0.954
MILITARY	0.641***	1.898	0.588***	1.801
OFFICE.ADMINISTRATIVE	-0.742***	0.476	-0.243***	0.784
OTHER	0.585***	1.795	-0.030	0.970
OTHER.HOUSEWIFE	-1.433***	0.239	-0.348***	0.706
PERSONAL.CARE.SERVICE	-0.087	0.917	0.097*	1.102
PRODUCTION	-0.237***	0.789	-0.011	0.989
PROTECTIVE.SERVICE	0.406***	1.500	0.355***	1.426
SALES	-0.114**	0.893	-0.077	0.926
TRANSPORTATION.MATERIAL.MOVING	0.116**	1.123	-0.021	0.979

Figure 5: Result for the regression

To further accurately identify the impact of occupational choice, we add the quantifiable factors of occupation-related salary and working hours to measure whether the nature of the occupation itself has an impact on the probability of suicide. Two figures below show the preliminary links between wages, working hours, occupation and suicide rates. We can observe that the higher the average wage, the higher the suicide rate, probably largely due to the high competition in these industries. However, this correlation is not significant and there are many outliers, such as the management and lawyer professions, where wages are higher but suicide rates do not increase accordingly, possibly because their high wages are sufficient to compensate for the stress caused by competition. In terms of working hours, the correlation is not significant, probably because working hours here are occupationally averaged and it is difficult to include data

on hours worked outside of working hours.

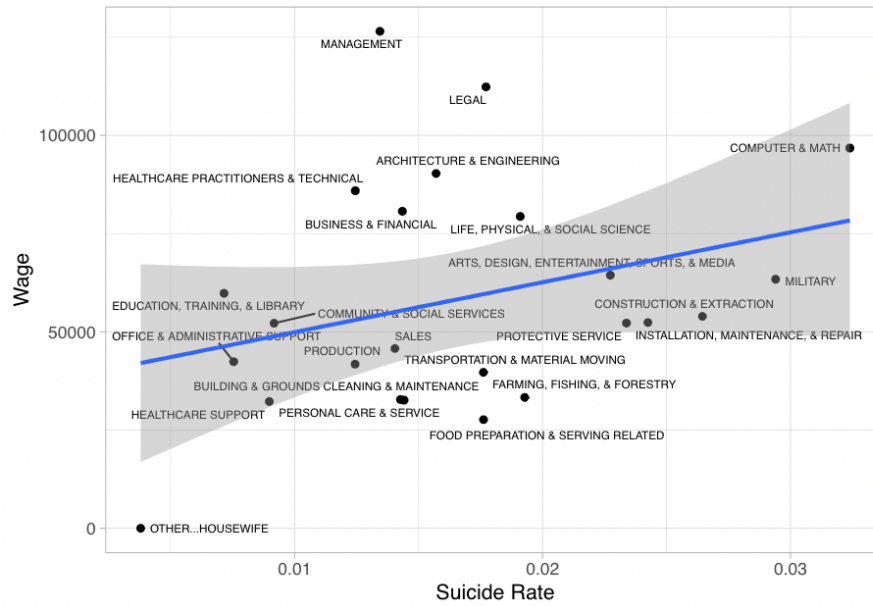


Figure 6: Suicide Rate and Occupation Wage

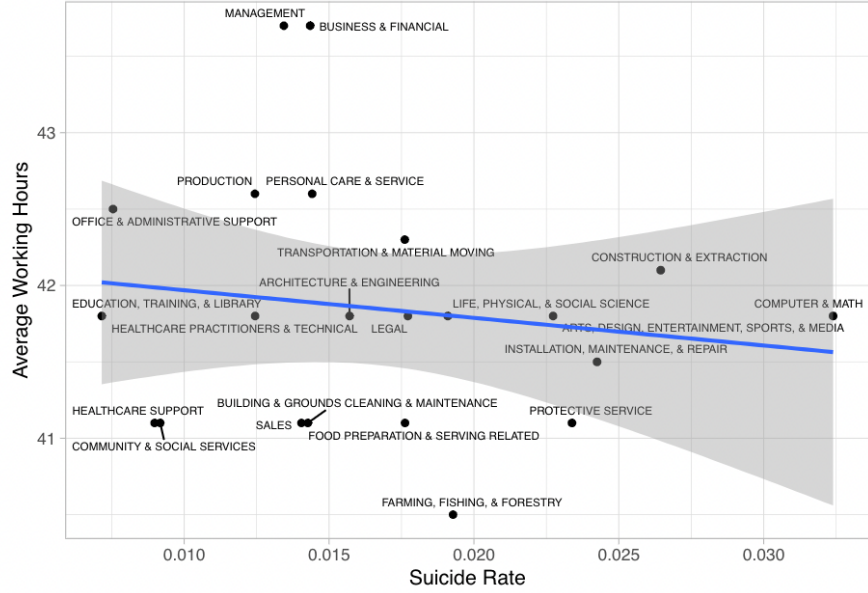


Figure 7: Suicide Rate and Occupation Working Hours

Figure 8 shows the occupations that still have a significant effect on the probability of suicide after controlling the personal and occupation-related variables. We can find that community and social services, education, food preparation and serving, and office administration have relatively low suicide rates compared to engineering. These occupations require more communication with others and people are less likely to generate negative emotions, which results in a lower possibility of suicide. In contrast, protective service and military (although not significant) have much higher suicide probabilities relative to the baseline after controlling for all variables, which we believe may be related to the trauma they experienced during their work. The healthcare-related occupations, after controlling the effects, have the similar overall suicide possibility as engineering, implying minimal influence from the nature of the occupation.

	Estimate	Std. Error	z value	Pr(> z)
occuARTS, DESIGN, ENTERTAINMENT, SPORTS, & MEDIA	0.156	0.048	3.224	0.001
occuBUILDING & GROUNDS CLEANING & MAINTENANCE	-0.122	0.046	-2.672	0.008
occuCOMMUNITY & SOCIAL SERVICES	-0.382	0.065	-5.884	0.000
occuCOMPUTER & MATH	0.290	0.051	5.649	0.000
occuEDUCATION, TRAINING, & LIBRARY	-0.420	0.050	-8.482	0.000
occuFOOD PREPARATION & SERVING RELATED	-0.227	0.044	-5.123	0.000
occuINSTALLATION, MAINTENANCE, & REPAIR	0.169	0.041	4.150	0.000
occuOFFICE & ADMINISTRATIVE SUPPORT	-0.234	0.042	-5.516	0.000
occuPROTECTIVE SERVICE	0.351	0.046	7.692	0.000

Figure 8: Final Result

In our model, it is difficult for us to include all factors and there might be unobserved factors affecting the suicide probability. The data may also not satisfy the assumptions of the model and in order to obtain unbiased estimates and determine causality, we therefore need to apply identification strategies for further processing. We would use the strategy of discontinuity, i.e. we assume that occupations, which are similar in ways of working, should be clustered in terms of suicide probabilities. Thus, we categorize the broad occupations into management, technical, service, healthcare related, military related, labour intensive and others. The technical categories include computer and math, engineering, social science, etc.; The service categories include food service, sales, etc.; the labour-intensive categories include production, farming and fishing, etc. These broad categories have certain commonalities in terms of the way they work. When we include the dummy variable of broad categories, the robustness of the coefficients can show the relative relationship between broad categories and the probability, which implies whether they are clustered similar to the mode of their work.

Category	Coefficient	Odds Ratio
CataManagement	-0.012 *	0.988
CateTechnical	0.232 ***	1.261
CateService	-0.085 **	0.918
CateHealthcare	0.043	1.043
CateMilitary	0.541 ***	1.717
CateLaborCentered	0.112 *	1.118

5 Conclusion

Our focus is on the different occupations, which allows us to explore nature of different occupations such as pressure and trauma. Based on the research and empirical results, the nature of different occupations has a significant effect on

the possibility of suicide, which is in accordance with our initial hypothesis. In this paper, we build up logit models relying on different controlled variables. In details, the controlled variables can be separated in two categories: individual characteristics and occupation-related variables. Since engineering job has been set to be the baseline, occupations except healthcare-related are correlated with the nature of occupations.

Our result reveals the central role of occupations in suicide possibilities. Traditionally, the research directions focus on working hour and wages, which are essential factors that can influence suicide. However, we demonstrate that a considerable reason of suicide gap in occupations can be explained by the nature of occupations such as potential pressure. These findings are useful for not only firms but also government to construct plans to reduce the possibilities of suicide.

There are two main limitations in this study. First, this paper did not address the family history of suicide covariate in the model due to the lack of related information in the data set. People with a family history of completed suicide and psychiatric illness have a higher suicide risk (Qin et al., 2002). This might bias the suicide rates in different occupations since the proportion of people who have a family history of suicide or a mental illness in each occupational group is unknown. Second, it was necessary to be cautious about the results because the COVID-19 outbreak a pandemic in March 2020 in the United States and industries have been affected to various degrees. Although we have excluded the confounding factors, the effect of COVID-19 on the suicide rate among different working-population remains unclear.

Our study on the effect of career choices on the probability of suicide is rather general and crude, but we can provide some references for subsequent studies. Research into the relationship between occupational choice and suicide rates could be deepened in several ways. For example, the effect of a broad type of occupations, e.g. labor intensive occupations, on suicide rates could be studied in depth so that the model could be more detailed and precise, and occupation-related surveys could be included to identify more complex psychological reasons for choosing to commit suicide.

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