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Does COVID-19 Affect the Pricing Determinants of Green Bonds? Evidence From Chinese Market By Nongxin Ai

Abstract

In this study, we examined the pricing determinants of green bonds in the Chinese bond market before and after the outbreak of COVID-19 to explore whether the pandemic structurally changed the risk factors of the green bond. We apply OLS regression with interaction terms and find that COVID-19 has significantly affected the risk factors of the green bonds. For example, after the pandemic, the insurance effect of certification of green bonds disappears, instead, the market requires higher yield for those labeled bonds. Following the analysis and regression result, we propose some policy suggestions.

Introduction

The outbreak of COVID-19 influences the global economy greatly. The health crisis has not only tragically caused lots of deaths but has also seriously damaged market confidence and economic activity. The outbreak of COVID-19 has a significant impact on the global economy. This health crisis not only tragically causes a massive loss of life, but also severely damages market confidence and economic activity. World stocks retreated from record highs to record their biggest weekly losses since the 2008 global financial crisis. The International Monetary Fund (IMF) has called the economic crisis caused by COVID-19 a "lockdown" and forecast that global economic growth will fall to 3% in 2020 World stock markets retreated from record highs, reporting the biggest weekly drop since the global financial crisis in 2008. The International Monetary Fund (IMF) described the economic crisis caused by COVID-19 as a " lockdown " and predicted that global economic growth would fall to 3% by 2020. ((Song et al., 2020). The Chinese financial market remains generally stable compared with overseas markets despite the spread of the COVID-19 ((Nuhu 2020).

Green bonds are bonds that raise money for environmental projects. Green bonds are designed to finance projects with positive environmental or climate change benefits. Most of the green bonds or funds in issue have a green purpose or are linked to green assets. In 2019, China was the largest source of labeled green bonds. In 2019, the total amount of Chinese green bonds issued in both domestic and overseas markets reached USD55.8bn (RMB386.2bn), representing a 33% increase from the USD42bn (RMB282.6bn) in 2018 (China Green Bond Market 2019

Research Report 2020). In 2019, the total issuance of Chinese green bonds in domestic and overseas markets reached US$55.8 billion (RMB386.2 billion), an increase of 33% from US$42 billion (RMB282.6 billion) in 2018, making China the largest source country for labeled green bonds. Green bonds have the characteristic of sustainability. With the development of technology and society, more people are starting to become aware of the importance of protecting the environment and preserving natural resources while profiting, which also fits the concept of ESG and CSR. One of the distinguishing features of green bonds is sustainability. With the development of technology and society, there is a growing awareness of the importance of protecting the environment and preserving natural resources while making a profit, which is in line with the concepts of ESG (environmental, social, and governance) and CSR (corporate social responsibility). As a kind of bonds that meet the concept of ESG and CSR, green bonds developed rapidly in these years. What's more, the pandemic has brought ethical performance under greater scrutiny and highlighted the value of resilience over efficiency. The shift to a new reality is an unprecedented opportunity to embed ESG at the heart of an organization's mission and operations (ESG: Environmental, Social, Governance). Therefore, it is important to figure out the impact of COVID-19 in the green bonds market.

In the article *The impacts of the COVID-19 pandemic on China's green bond market*, the author analyzes the Chinese green bonds market during the pandemic and finds out the influences of the pandemic in green bonds' CAR and EMP. Yi et al. (2021)analyze the Chinese green bond market during the pandemic and find the impact of the pandemic on green bond CARs and EMPs. In the paper Exploring the determinants of green bond issuance: Going beyond the long-lasting debate on performance consequences, the author concludes the pricing of green bonds using global samples. Russo et al. (2021) conclude with a global sample on the pricing of green bonds. In the article The Impact of the COVID - 19 on the Financial Markets: Evidence from China and USA, the influences of the outbreak of COVID-19 on the economy based on China and USA samples are discussed. Sansa (2020) discusses the economic impact of the COVID-19 outbreak based on Chinese and U.S. financial markets. However, there is still no research focusing on how COVID-19 specifically affects the green bond in Chinese markets.

In this study, we collect the data of green bonds from the Wind database with the window from 2016 to present. OLS regression is applied to analyze the dataset and reveals that the pricing determinants of green bonds have structural change due to the shock of COVID-19. This

study fills the gap of examining the influence of COVID-19 on the Chinese bond market in terms of bond pricing determinants with the special focus on green bonds. Moreover, this study offers policy suggestions based on the analysis result to help the government better manage financial risk when facing significant external shock.

In the second section, a literature review about the current research of green bonds and green bonds pricing and the impact of COVID-19 is presented. The third section is the introduction of data used in the paper. In the fourth section, the methodology is explained. The fifth section is about data analysis and our model. Finally, the last section is the conclusion.

Data

The data of this study is from the green bonds section of the Chinese market in Wind Database. It covers all green bonds issued in and after 2016. In 2016, Shanghai Stock Exchange launched a pilot program for green bonds, marked as a great milestone of the development of the Chinese green bond market. There are 2183 green bond samples in this dataset. In order to examine the impact of COVID-19 on the Chinese green bond market with comparative study. The whole dataset is divided into two subgroups: green bonds issued before 2020-01-23 and green bonds issued on or after 2020-01-03. The reason why 2020-01-23 is selected for splitting the dataset is that on 2020-01-23 Wuhan was locked down due to the outbreak of COVID-19. After the split, there were 932 green bond samples issued before the outbreak of COVID-19 and 1251 green samples issued after that. Apart from dependent variable *Coupon Rate*, which is the interest cost at issuance, there are 10 independent variables which are shown in Table 1.

Table 1. Variable List

Variable	Explanation
Issue Size	Indicating how much the issuer issued (in 100 million CNY)
Debt Credit Rating	Bond credit ratings conducted by external rating agencies

Entity Credit Rating	Issuer's entity credit ratings conducted by external rating agencies
Industry	Categorical variable indicating the industry where the issuer is in
Bond type	Categorical variable indicating the type of the bond, such as mid-term notes or asset-backed securities.
Frequency of Interest Payment	Indicating how often the issuer pays back the interest.
Listed	Categorical variable indicating whether the company is listed.
Entities	Categorical variable indicating the type of issuers. E.g. Central government owned enterprises and private enterprises
Certification	Indicating whether the bond is certified by a third party as green bonds.
Embedded Options	Indicating whether the green bond has any embedded options.
B/A	Indicating whether the green bond was issued before or after the COVID-19

In this study, categorical variables are processed and encoded to input the regression model as dummy variables. For those ordinal data such as bond credit ratings and entity credit ratings, it is processed by encoding them according to the extent. For example, "AAA" indicates the highest rating, it is encoded as 11. And the rating level right below it, "AA+", is encoded as 10. In this case, we make sure that all variables can be expressed in numerical format.

Methodology

From the previous studies, we can conclude that the outbreak of COVID-19 has great impacts on the volatility of the green bond market, reduces investors' interest in investing in green projects, and affects the price of green bonds dramatically. The COVID-19 pandemic and the following economic downturns contributed to a significant reduction in fossil fuel prices. Low fossil fuel prices can help traditional energy projects lower the associated cost thus is harmful to developing renewable energy projects, making renewable energy resources less attractive. This reduces investors' interest in clean fuels (Taghizadeh-Hesary et al., 2021). Also, given the discussion in previous sections that COVID-19 has already significantly affected the financial market globally, we assume that ***the pricing determinants of green bonds are influenced by COVID-19***.

In this study, OLS regression is applied to examine the significance of the independent variables with respect to the dependent variable *Coupon Rate*. The model can be expressed as:

$$Coupon\_Rate_i = \alpha + \sum_{j=1}^{k} \beta_j x_{i,j} + \varepsilon_i$$

where α is the intercept, β_j is the coefficient for j-th variable, and ε_i is the error term.

In particular, we use stepwise regression in our study to keep only those highly significant determinants and keep the model out of multicollinearity. Since our dataset contains many variables, we input all variables first, then gradually drop out the least significant variables, with 99% significance instead of 95% as the retention criteria. The OLS regression is performed on the entire data, data before COVID-19 and data after COVID-19, respectively. To ensure the robustness of the model, after the establishment of the above model, we also conduct an interaction term to explain the difference of time influencing factors on the price of green bonds together with pre-set independent variables, by multiplying variable *B/A* with all other variables. By observing the statistical significance of the interaction term, we can understand which variables have significant change in different time periods.

Empirical Results

First, we conduct the exploratory data analysis with the collected data by univariate and bivariate analysis to better understand data and do some preliminary analysis. Exploratory data

analysis can also shed light to the main modeling part. In this part, we use Python to do the analysis and data visualization.

Figure 1. Bond Type Analysis

From Figure 1 we can see, in our samples, the three kinds of green bonds with the biggest issue amount are local government bonds, corporate bonds and asset-backed securities. Before the start of the pandemic, the proportion of these bonds were 45.76%, 17.17% and 13.59%. However, after the outbreak of COVID-19, the proportion changed to 47.99%, 12.86% and 13.60%. The proportion of the government bond increases significantly while the proportion of corporate bond falls significantly, and the proportion of asset-backed bonds almost remains constant. Since the economy is experiencing a slow recovery after the pandemic, investors tend to choose safer investment products. Therefore, the proportion of government bonds increases.

Figure 2. Issuer Type Analysis

```
Here is the data before COVID-19:
Local State-owned Enterprise 337
Central State-owned Enterprise    80
Private Enterprise    46
Public Enterprise 13
Sino-foreign Joint Venture    6
Wholly Foreign-owned Enterprise    1
Name: Enterprise Category, dtype:int64
Local State-owned Enterprise 69.772257
Central State-owned Enterprise    16563147
Private Enterprise    9.523810
Public Enterprise 2.691511
Sino-foreign Joint Venture    1.242236
Wholly Foreign-owned Enterprise  0.207039
Name: Enterprise Category, dtype: float64
```

```
Here is the data after COVID-19:
Local Government Bond  586
Asset-backed Bond  166
Corporate Bond  157
Enterprise Bond  120
Medium Term Note  119
Financial Bond  36
Short-term Financing Bond    29
PPN7
PRN
Name: Wind Classification of bonds, dtype:int64
Local Government Bond  47.993448
Asset-backed Bond  13.595414
Corporate Bond  12.858313
Enterprise Bond  9.828010
Medium Term Note  9.746110
Financial Bond  2.948403
Short-term Financing Bond    2.375102
PPN0.573301
PRN0.081900
Name: Wind Classification of bonds, dtype:float64
```

```
Here is the data after COVID-19:
Local State-owned Enterprise 388
Central State-owned Enterprise    146
Private Enterprise    30
Public Enterprise 5
Wholly Foreign-owned Enterprise  3
Sino-foreign Joint Venture    2
Collective Enterprises    1
Name: Enterprise Category, dtype: int64
Local State-owned Enterprise 67.478261
Central State-owned Enterprise    25.391304
Private Enterprise    5.217391
Public Enterprise 0.869565
Wholly Foreign-owned Enterprise  0.521739
Sino-foreign Joint Venture    0.347826
Collective Enterprises    0.173913
Name: Enterprise Category, dtype: float64
```

```
LGFV
Here is all the data:
0    1756
1    427
Name: LGFV, dtype: int64
0    80.439762
1    19560238
Name: LGFV, dtype: float64
--------------------
Here is the data before COVID-19:
0    766
1    166
Name: LGFV, dtype: int64
0    82188841
1    17811159
Name: LGFV, dtype: float64
--------------------
Here is the data after COVID-19:
0    990
1    261
Name: LGFV, dtype: int64
0    79136691
1    20863309
Name: LGFV, dtype: float64
```

```
Here is all the data:
Local State-owned Enterprise 725
Central State-owned Enterprise    226
Private Enterprise    76
Public Enterprise 18
Sino-foreign Joint Venture    8
Wholly Foreign-owned Enterprise  4
Collective Enterprises    1
Name: Enterprise Category, dtype:int64
Local State-owned Enterprise 68.525520
Central State-owned Enterprise    21.361059
Private Enterprise    7.183365
Public Enterprise 1.701323
Sino-foreign Joint Venture    0.756144
Wholly Foreign-owned Enterprise  0.378072
Collective Enterprises    0.094518
Name: Enterprise Category, dtype:float64
```

Figure 3. Analysis for Variable *Local Government Financing Vehicle*

The analysis for the types of issuers is presented in Figure 2. For the issuer, 69.77% of the green bonds are issued by local government-owned enterprises, 16.56% are Central government-owned enterprises, and 9.52% are private companies. After the pandemic, 67.48% of the green bonds were issued by local government-owned enterprises, 25.39% were central government-owned enterprises, and 5.21% were private companies. This may be mainly caused by the fact that government bonds are often more reliable with higher credit rating, while corporate bonds are relatively riskier. After the pandemic, the economy is recovering from the shock. Therefore, people would prefer the safer bond, so government bonds become more popular, and the proportion thus increases. This can also be proved by the data from our samples that the proportion of *Local Government Financing Vehicle* (LGFV) is 17.81% before the pandemic and increases to 20.86% after it, since investors trust government more compared to private-owned enterprises, which is shown in Figure 3.

```
Here is all the data:                              Here is the data before COVID-19:           Here is the data after COVID-19:
Industrial      565                                Industrial      242                         Industrial      323
Public Utility 283                                 Public Utility 103                          Public Utility 180
Finance 177                                        Finance 96                                  Finance 81
Real Estate 39                                     Material 22                                 Real Estate 28
Material 39                                        Consumer Discretionary  12                  Material 17
Consumer Discretionary  25                         Real Estate  11                             Consumer Discretionary  13
Health Care 9                                      Health Care 9                               Energy  4
Energy  8                                          Energy  4                                   IT  2
IT  5                                              IT  3                                       Daily Consumption  1
Daily Consumption   3                              Daily Consumption   2                       Name: Industry Involved, dtype: int64
Name: Industry Involved, dtype: int64              Name: Industry Involved, dtype: int64       Industrial      49.768875
Industrial      49.002602                          Industrial      48.015873                   Public Utility 27.734977
Public Utility 24.544666                           Public Utility 20.436508                    Finance 12.480740
Finance 15.351258                                  Finance 19.047619                           Real Estate 4.314330
Real Estate 3.382480                               Material 4.365079                           Material 2.619414
Material 3.382480                                  Consumer Discretionary  2.380952            Consumer Discretionary  2.003082
Consumer Discretionary  2.168257                   Real Estate  2.182540                       Energy  0.616333
Health Care 0.780572                               Health Care 1.785714                         IT  0.308166
Energy  0.693842                                   Energy  0.793651                            Daily Consumption   0.154083
IT  0.433651                                       IT  0.595238                                Name: Industry Involved, dtype: float64
Daily Consumption   0.260191                       Daily Consumption   0.396825
Name: Industry Involved, dtype: float64            Name: Industry Involved, dtype: float64
```

Figure 4. Industry Analysis

  Before the COVID-19, 48.02% of the sample bonds were about industry, 20.44% were about public utilities, and 19.05% were about financial. After the pandemic outbreak, the top 3 categories are industry, public utilities and financial with the percentage 49.76% , 27.73% and 12.28%, respectively. Since the financial industry depends mostly on the real economy, the government will vigorously develop the real economy to promote the recovery and development of the economy after the pandemic. Therefore, the financial system would not be a priority for economic development. Therefore, after experiencing the shock of COVID-19, to revive the economy, the government would like to develop fundamental public utilities to accelerate the economic cycle and increase employment. Also, less financial enterprises would choose to issue bonds during the pandemic. As a result, the proportion of financial green bonds decreases.

```
Certification
Here is all the data:
0    1658
1    525
Name: Certification, dtype:int64
0    75.950527
1    24.049473
Name: Certification, dtype: float64
------------------------------
Here is the data before COVID-19:
0    719
1    213
Name: Certification, dtype: int64
0    77.145923
1    22854077
Name: Certification, dtype: float64
------------------------------
Here is the data after COVID-19:
0    939
1    312
Name: Certification, dtype: int64
0    75059952
1    24.940048
Name: Certification, dtype: float64
```

Figure 5. Analysis on Labeled Green Bonds

22.85% of the green bonds were labeled before pandemic, while after the pandemic, this number reaches 24.94%. This is because, due to people's preference of lower risk bonds, more green bonds are certificated to attract investors serving as an insurance.

Moreover, the top 3 entity rating of the green bonds is 47.95% for AAA+, 28.49% for AA, and 20.00% for AA+. After the pandemic, it turned to 50.32% for AAA+, 26.24% for AA, and 20.22% for AA+. It can also be found out that the overall credit rating of green bonds decreases after the pandemic, which means the requirement for the company to issue green bonds is lower after the COVID-19. The credit rating of green bonds before the pandemic is 77.68% of AAA, 10.41% of AA+ and 5.26% of AA. After the outbreak of COVID-19, it changed to 75.22%, 14.23% and 8.31%. This may be caused by the fact that enterprises also have less funds because of the pandemic, therefore, their ratings fall. This can also be proved by the data that before the pandemic, 9.97% of the green bonds are listed bonds, however, after pandemic, only 7.75% of them are listed.

```
Embedded Options
Here is all the data:
0    1469
1    714
Name: Embedded Options, dtype: int64
0    67.29271632707284
1    32.707284
Name: Embedded Options, dtype: float64
————————————————
Here is the data before COVID-19:
0    614
1    318
Name: Embedded Options, dtype: int64
0    65.87982834120172
1    24.120172
Name: Embedded Options, dtype: float64
————————————————
Here is the data after COVID-19:
0    855
1    396
Name: Embedded Options,dtype:int64
0    68.34532431.654676
1    31.654676
Name: Embedded Options, dtype:float64
```

Figure 6. Embedded Options Analysis

The impact of COVID-19 on the green bond markets can be also observed regarding the embedded options. In our dataset, before pandemic, 34.12% of the green bonds have embedded options. However, after the pandemic, only 31.65% of the bonds have. Enterprises have fewer money, therefore, they decrease the embedded option in green bonds.

Number of interest payments per year increased dramatically after the COVID-19, which can be found in Figure 7. Before the pandemic, the proportion of the number of interest payments per year for 1, 2, 4, and times was 56.89%, 37.89%, 5.21%, respectively. However, the proportion changed to 52.46%, 41.30%, 6.00% after the outbreak of COVID-19. Commonly, 12 times payment can hardly be seen in the green bonds market. However, after the pandemic, there are even 3 bonds that have 12 times payment per year. Because of the economic loss caused by COVID-19, issuers could afford less risk, therefore, the proportion of green bonds that have embedded options decreases. Similarly, investors' ability to afford risk also drops, so they would like to increase the times of interest payment per year. The increased number of interest payments means more frequent cash flows for investors, who are better able to meet their preference to manage a portion of the liquidity in their portfolios.

```
Number of interest payments per year
Here is all the data:
1.0  1020
2.0  979
4.0  120
12.0 3
Name: Number of interest payments per year, dtype: int64
1.0  48.067861
2.0  46.135721
4.0  5.655042
12.0 0.141376
Name: Number of interest payments per year, dtype: float64
_____
Here is the data before COVID-19:
1.0  524
2.0  349
4.0  48
Name: Number of interest payments per year, dtype: int64
1.0  56.894680
2.0  37.893594
4.0  5.211726
Name: Number of interest payments per year, dtype: float64
_____
Here is the data after COVID-19:
2.0  630
1.0  496
4.0  72
12.03
Name: Number of interest payments per year,  dtype: int64
2.0  52.456286
1.0  41.298918
4.0  5.995004
12.0    0.249792
Name: Number of interest payments per year, dtype: float64
```

Figure 7. Number of Interest Payment Per Year Analysis

As for the continuous numerical variables, in our sample green bonds, the issue amount of green bonds changes from 13.37 billion on average to 12.37 billion because of the pandemic. The maximum issue amount of green bonds before pandemic is 300 billion and drops dramatically to 192 billion after pandemic. The minimum increases from 0.048 to 0.11o billion. Obviously, green bonds are affected greatly by the slow growth of the economy and the development of green bonds also decreases.

Different from the interest cost, the mean maturity increases from 8.17 years to 10.19 years, and the median also increases from 7 years to 7.9 years. This may be caused by the fact that issuers need a longer repayment period, so green bond issuers may need a longer maturity. As the dependent variable, the mean interest cost of green bonds changed from 4.38% to 4.00% after the pandemic happen. The maximum interest cost increases from 10.75% to 13.00%. This means that the overall financing cost decreases. Also, issuers may also invest in other industry, since this investment may also be influenced by the pandemic, they may need a longer maturity to pay. Since the longer the maturity of a bond is, the more the issuers would need to pay for a higher interest rate, therefore, the interest rate may thus decrease.

```
Here is all the data:
               Maturity          Issue Amount
Maturity       1.000000          0.039123
Issue Amount   0.039123          1.000000
-------------------------------
Here is the data before COVID-19:
               Maturity          Issue Amount
Maturity       1.000000          -0.044629
Issue Amount   -0.044629         1.000000
-------------------------------
Here is the data after COVID-19:
               Maturity          Issue Amount
Maturity       1.000000          0.107885
Issue Amount   0.107885          1.000000
```

Figure 8. Correlation Between Maturity and Issue Amount

We also conduct correlation analysis. In our samples, the issue amount and maturity have a low and negative correlation -0.044629 before the pandemic and a low and positive correlation 0.107885 after the pandemic (see Figure 8), which means that the increase in issue amount of the green bonds would result in a bit decrease in the maturity before pandemic, and changes inversely after the pandemic. Since the longer the maturity of a bond is, the more the issuers would need to pay for a higher interest rate.

```
Here is all the data:
               Entity Rating     Bond Rating
Entity Rating  1.000000          -0.352234
Bond Rating    -0.352234         1.000000
-------------------------------
Here is the data before COVID-19:
               Entity Rating     Bond Rating
Entity Rating  1.000000          -0.237365
Bond Rating    -0.237365         1.000000
-------------------------------
Here is the data after COVID-19:
               Entity Rating     Bond Rating
Entity Rating  1.000000          -0.432578
Bond Rating    -0.432578         1.000000
```

Figure 9. Correlation Between Entity Rating and Bond Rating

Figure 9 reveals the correlation of entity rating and bond rating are both negative and low related before and after the pandemic, with -0.237365 before and -0.432578 after. After the COVID-19, since the overall credit rating both falls, to get a better bond rating to get a lower interest rate, the bonds rating may increase more. Also, a guarantor with better credit to guarantee the bonds or collateral could raise the rating of the debt, thus leading to stronger negative correlation.

Regression

The first model (see Figure 10) is about the OLS regression of interest cost (Coupon Rate) as Y variable with other X variables in all 2183 samples. The interest cost has a negative correlation with the issue amount, since the big issue amount means that enterprises need to pay more money, therefore, the interest cost needs to be smaller. The correlation between the interest cost and the embedded options is marked as positive. This is because the embedded options can give the issuer more flexibility in terms of payment schedule or adjustable interest, which would increase the interest cost. The coupon rate is negatively correlated with the bond maturity. The longer the maturity is, the more uncertain the external market environment would be. Therefore, the investors require a risk premium regarding the future uncertainty. Bond credit rating is definitely negatively linked with the dependent variable, which is proven correct as well in this study. Also, the influences of interest cost vary greatly in different industries, which means that industry is also a significant factor of influencing the green bonds pricing. The Real estate industry has a high coefficient 2.57, which means that it may have a big bond interpolation.

```
                                OLS Regression Results
========================================================================================
Dep. Variable:Model:            Interest Cost R-squared:                          0.583
                                OLS Adj. R-squared:Least Squares F-statistic:      0.579
                                                                                  137.5
Method:Date:
                                Fri, 10 Sep 2021 Prob (F-statistic):11:15:53 Log-Likelihood:   0.00-2645.7
Time:
No. Observations:               2183        AIC:                                  5337.
Df Residuals:                   2160        BIC:                                  5468.
Df Model:                       22
Covariance Type:                nonrobust
========================================================================================
```

	coef	std err	t	P>|t|	[0.025	0.975]
const	3.1560	0.158	19.991	0.000	2.846	3.466
Issue Amount	0.0035	0.001	3.836	0.0 0	0.005	0.002
Embedded Options	0.3897	0.049	7.884	0.000	0.293	0.487
Maturity	0.0299	0.003	9.022	0.0 0	0.023	0.036
Bond_Rating	0.2089	0.015-13.878		0.000	0.238	0.179
Corporate bonds	0.9730	0.084	11.647	0.000	0.809	1.137
Corporate bonds	0.7584	0.076	9.930	0.000	0.609	0.908
Exchangeable bonds	2.3488	0.838	2.802	0.005	3.993	0.705
Local government debt	0.9679	0.167	5.792	0.000	0.640	1.296
Short-term financing bonds asset-backed	1.7073	0.174	9.812	0.000	2.049	1.366
securities	1.0813	0.077	13.994	0.000	0.930	1.233
Sino-foreign joint ventures public	1.1614	0.322	3.609	0.000	1.792	0.530
enterprises local state-owned	0.8697	0.205	4.237	0.000	0.467	1.272
enterprises private	0.5225	0.065	8.042	0.000	0.395	0.650
enterprises	1.6722	D.122	13.741	0.0 0	1.434	1.911
utilities	0.8963	D.162	5.518	0.	0.578	1.215
Health care	1.1127	0.323	3.445	0.001	0.479	1.746
Optional consumer	0.9609	D.226	4.250	0.000	0.518	1.404
industries	1.0019	0.162	6.178	0.	0.684	1.320
The real estate	2.5746	0.214	12.031	0.0 0	2.155	2.994
material	0.8554	0.205	4.165	0.000	0.453	1.258
energy	1.5203	0.331	4.590	0.000	0.871	2.170
financial	0.7911	0.167	4.751	0.000	0.465	1.118

```
========================================================================================
Omnibus:                        Durbin Watson - 331.024:                          1.100
Prob ( Omnibus):                0.000 Jarque Bera (JB) :                           1877.654
Skew:                           0.585 Prob(JB) :7.390 cond.                        0.00
Kurtosis:                       No.                                               1.20 e+03
========================================================================================
```

Figure 10. OLS Regression Results for All Data

The second model (see Figure 11) is about the OLS regression of interest cost as Y variable with other X variables in 932 sample green bonds issued before pandemic. The R-square of this model is 0.675 and 0.668, which is much different between the previous R-square 0.583 and 0.579. This means that the model could better interpret the pricing determinants before the outbreak of COVID-19 with almost 70% of the green bonds before and less than 60% of the green bonds after. The correlation of issue amount, maturity, embedded option, and bond rating remains the same. The certification has a negative relationship -0.4193 with interest rate. In our previous review, we also conclude that investors are willing to accept a lower yield for green bonds with certification for its lower risk.

OLS Regression Results

Dep. Variable:Model:	Interest Cost		R-squared:			0.675
			OLS Adj. R-squared:			0.668
Method:Date:	Least Squares		F-statistic:			111.4
	Fri, 10 Sep 2021 Prob (F-statistic):11:16:39 Log-Likelihood:					5.89 e-209
Time:						1005.1
No. Observations:	932					In 2046,
Df Residuals:			AIC:914 BIC:			2133.
Df Model:	17					
Covariance Type:	nonrobust					

	coef		std err	t	P>|t|	[0.025	0.975]
constIssue Amount.	3.0543		0.207	14.790	0.000	2.649	3.460
	0.0036	1	0.001	3.466	0.001	0.006	0.002
Certification	0.4193		0.091	4.585		0.599	0.240
Embedded Options	0.2655	1	0.071	3.721	0.000 . 0 00.000	0.125	0.406
Maturity	0.0217		0.005	3.982			0.032
Bond_Rating	0.3387		0.025		- 13.363 -	0.000	0.011 0.3 81.942	0.289
Medium-term notes	2.4753		0.272	9.114	0.000		3.008
Corporate bonds	2.8242		0.250	11.310	0.000	2.334	3.314
Corporate debt Local government debt	2.8862		0.239	12.069	0.000	2.417	3.355
	1.9462		0.239	8.139	0.000	1.477	2.415
Directional instruments	1.8551		0.331	5.606	0.0 00.000	1.206	2.504
asset-backed securities financial debt	3.3502		0.249	13.448		2.861	3.839
	2.0687		0.259	7.985	0.000	1.560	2.577
Sino-foreign joint venture public enterprise local	1.9314		0.449	4.303	0.000	2.812	1.051
state-owned enterprise private enterprise	0.7733		0.223	3.460	0.001	0.335	1.212
	0.6528		·	7.430	0.000	0.480	0.825
	1.3776		0.132	10.425	0. 0.000	1.118	1.637
The real estate	2.0000		0.329	6.0		1.355	2.645

Omnibus:		1.085283.486
Prab (Omnibus):	92.509 Durbin-Watson:0.000 Jarque-Bera	
Skew:	(JB):0.479 Prob (JB): 5.526 cond. No.	
Kurtosis:		2.77 e-62771,

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

Figure 11. OLS Regression Results for Samples Issued before COVID-19

The third model (see Figure 12) is about the OLS regression of interest cost as Y variable with other X variables in 1251 sample green bonds issued after pandemic. Compared to green bonds issued before pandemic, the R-square drops drastically with 0.607, which means that the scope that the model fits is smaller. The correlation of issue amount, maturity, embedded option, and bond rating remains the same. However, the correlation between certification and issue amount changed to the positive number 0.2913 instead of the negative number -0.4193 after the outbreak of CPVID-19. The medium-term notes also change greatly with the previous significant positive coefficient 2.4753 to the significant negative coefficient -1.0588. The Non-public directed debt financing instruments, financial bonds, local state-owned enterprises bonds also changed from a positive correlation with interest cost to a negative correlation after the pandemic.

OLS Regression Results

Dep. Variable:Model:	Interest Cost R-squared:					0.607
	OLS Adj. R-squared:Least Squares F-statistic:					0.600
Method:Date:						90.441.2 le - 231
Time:	Fri, 10 Sep 2021 Prob (F-statistic):11:16:58 Log-Likelihood:					1463.3
No. Observations:Df Residuals:	1251 AIC:					2971.
	1229 BIC					3083.
Df Model:covariance Type:	21 nonrobust					

	coef	std err	t	P>|t	[0.025	0.975]
const	3.7083	0.111	33.357	0.000	3.490	3.926
Issue Amount	0-0037	0.001	2.701	0.007	0.006	0.001
Certification	0.2913	0.079	3.678	0.000	0.136	0.447
Embedded Options	0.4862	0.063	7.753	0.	0.363	0.609
Maturity	0.0369	0.004	9.167	0.	0.029	0.045
Bond_Rating	0.1654	0.018	- 9367.	00.000	0.200	0.131
Medium-term notes	1.0558	0.104	10.165	0.000	1.260	0.852
Corporate bonds	0.3183	0.111	2.861	0.004	D.100	0.537
Directional tool	0.8907	0.313	2.841	0.005	1.506	0.276
Short-term financing bonds Asset-backed securities financial bonds	2.2371	0.177	12.639	0.000	2.584	1.890
	0.3301	0.101	3.275	0.001	-D.528	0.132
	0.9012	0.203	4.439	0.000 . 0	1.299	0.503
Project revenue bills Central state-owned enterprises local state-owned enterprises public utilities	2.9227	0.813	3.596		4.517	1.328
	0.7452	0.127	5.858	0.0 0.000	0.995	0.496
	0.4746	0.109	4.344		0.689	0.260
	1.5258	0.143	10706	0.0	1-246.	1.805
Optional consumer industries	2.0355	0.257	7924	00.000	1.532	2.539
	1.6223	0.138	11.766	0.000	1.352	1.893
The real estate material energy financial	3.6957	0.182	20.292	0.000	3.338	4.053
	1.4786	0.228	6.472	0.000	1.030	1.927
	2.7691	0.419	6.603	0.000	1.946 . 6	3.592
	1.2543	0.188	6.678	0.000		1.623

Omnibus:			1.275
Prob (Omnibus) :	248.118 Durbin-Watson:0.000 Jarque-Bera		2428.283
Skew:	(JB):0.617 Prob(JB):9.713 cond.no		0.00
Kurtosis:			836

Figure 12. OLS Regression Results for Samples Issued after COVID-19

The fourth model (see. Figure 13) is about the OLS regression of interest cost as Y variable with other X variables in all 2183 samples. We can use this model to verify whether the results of the second and third models are robust. For the independent variable *certification*, the coefficient is -0.4099 regarding the interest cost. However, after multiple times, the coefficient changes to the positive number 0.6536. Adding these two numbers together, we can see a 0.2437 difference in the correlation of interest cost and certification after the pandemic. This matches with the result we reserved in the second and third model that the correlation of certification and interest cost changes from negative to positive because of the pandemic. For the independent variable bond ratings, the coefficient is -0.3450, while after multiplying the time, the coefficient of the interaction term is 0.2032. Adding them together, we can get a -0.1418. This shows that after the pandemic, the relationship between interest cost and bond rating became less relevant,

but the correlation is still negative. For mid-term notes, after multiplying the time, the correlation changes from 1.057 to -1.0193 and has the difference of 0.0277. For financial bonds, it changes from 0.7649 to -1.0091, and has a difference of -0.2442. This also fits our previous conclusion in the 5.1 section that the financial bonds are less popular after the outbreak of COVID-19. For local government-owned bonds, the coefficient changes from 1.3611 to -1.7620 after multiple times and has the difference of -0.4099. This also fits the fact that local government-owned bonds are becoming more popular since investors could accept a lower interest cost with a bigger issue amount.

OLS Regression Results

Dep. Variable:Model:	Interest Cost	R-squared:		0.648
	OLS	Adj. R-squared:		0.641
Methad:	Least Squares	F-statistic:		91.60
Date:	Fri, 10 Sep 2021	Prob (F-statistic):		
Time:	11:06:50	Log-Likelihood:		0.00-2461.6
No. Observations:	2183	AIC:		5011.
Df Residuals:	2139	BIC:		5262.
Df Model:	43			
Covariance Type:	nonrobust			

	coef	std err	t	P>|t|	[0.025	0.975]
const	3.6345	0.149	24.375	0.000	3.342	3.927
Issue Amount	0.0044	0.001	5.179	0.000	0.006	0.003
Certification	0.3690	0.097-3.805		0.000	0.559	0.179
Embedded Options	0.2481	0.074 3.371		0.001	0.104	0.392
LGFV	0.2972	0.103 2.883		0.004	0.095	0.499
MaturityBand_Rating	0.0207	0.006	3.637	0.000	0.010	0.032
	0.3305	0.025-13.152		0.000	0.380	0.281
Medium-term notes	0.9439	0.217	4.355	0.000	0.519	1.369
Corporate bonds	1.3035	0.165	7.884	0.000	0.979	1.628
Corporate debt	1.4079	0.178	7.929	0.000	1.060	1.756
Local government debt	1.3477	0.194	6.963	0.000	0.968	1.727
Short-term financing bonds Asset-backed securities financial bonds	0.5606	0.117	4.810	0.000	0.789	0.332
	2.0557	0.178	11.547	0.	1.707	2.405
	0.7112	0.208	3.427	0.001	0.304	1.118
Project Income bill	1.0102	0.401	2.521	0.012	1.796	0.224
Central state-owned enterprise public	0.8927	0.161	5.534	0.000	0.576	1.209
enterprise local state-owned	1.5223	0.262	5.800	0.0 0	1.008	2.037
enterprise wholly foreign-owned	1.3581	0.147	9.222	0.000	1.069	1.647
enterprise private enterprise	2.1193	0.775	2.735	0.006	0.600	3.639
	2.1340	0.172	|12.379	0.000	1.796	2.472
The real estate	1.3142	0.245	5.368	0.000	0.834	1.794
Certification x Time	0.6312	0.124	5.101	0.000	0.389	0.874
Embedded Options x Time	0.2220	0.094	2.368	0.018	0.038	0.406
LGFV x Time	0.4511	0.145-3.108		0.002	1 0.736	0.166
Maturity x TimeEntity Rating x Time	0.0156	0.007	2.285	0.022	0.002	0.029
	0.0852	0.016-5.436		0.000	0.116	0.054
Bond_Rating x Time	0.1872	0.030	6.232	0.000	0.128	0.246
Medium-term note x Time	0.9721	0.208	4.664	0.000	1.381	0.563
Corporate bonds x Time	0.4685	0.155	3.023	0.003	0.772	0.165
Local government bonds x Time	1.3653	0.175	7.822	0.000	1.708	1.023
short-term financing bonds x Time	0.5606	0.117	4.810	0.000	0.789	0.332
asset-backed securities x Time	2.3634	0.207	11.413	0.000	2.770	1.957
financial bonds x Time	1.0285	0.274	3.754	0.000	1.566	0.491
Project revenue note xTime	1.0102	0.401	2.521	0.012	1.796	0.224
Central state-owned enterprise xTime public enterprise X Time	1.6755	0.203	- .244	0.000	2.074	1.277
	1.2728	0.460	2.769	0.006	2.174	0.372
Local state-owned enterprises wholly foreign-owned enterprises privately owned enterprises	1.7604	0.188	9.354	0.000	2.129	1.391
	3.0814	0.895	1 3.443	0.001	4.837	1.326
	1.6056	0.297	5.400	0.000	2.189	1.023
Utility x Time Optional consumption x Time	1.4762	0.195	7.586	0.000	1.095	1.858
	1.8344	0.281	6.526	0.000	1.283	2.386
Industrial x Time	1.5844	0.197	058 .	0.000	1.199	1.970
Real Estate X Time	2.1746	0.353	6.153	0.000	1.482	2.868
Material x Time	1.3093	0.270	4.852	0.000	0.780	1.839
Energy x Time	2.6335	0.428	6.153	0.000	1.794	3.473
Financial x Time	1.2486	0.228	5.466	0.000	0.801	1.697

Omnibus:	320.678	Durbin-Watson:	1.177
Prob(Omnibus):	0.000	Jarque-Bera (JB):	2224.803
Skew:	0.492	Prob (JB) : 7.847	0.00
Kurtosis:		Cond. NO.	1.45 e+16

Figure 13. OLS Regression Results for All Data with Interaction Terms

Conclusion

In our study, we use 2183 samples from the Chinese green bonds market and conduct OLS regression models and stepwise regression models to research whether the outbreak of COVID-19 would impact the pricing determinants of green bonds. We use interest cost as Y variable and other factors, for example, certification, embedded option, bond rating, issue amount, entity rating, bond type, entities, frequency of payment and industry, as X variable. We divide over samples to two groups, green bonds issued before pandemic and green bonds issued after pandemic to better reserve their difference.

From our study, we find significant evidence that pandemics greatly affect the market of green bonds and the green bonds market is also experiencing slow growth like the present economy. However, the green bonds market is still popular. Because of the pandemic, the economy is facing downturns, so investors and enterprises are also facing the problem of slower cash flow. Therefore, certification and bond rating become more essential, and the frequency of interest payment also increases. The embedded option, the amount of green bonds issued by listed enterprises, green bonds in certain aspects, for instance, financial, also decreases. Bonds issued by certain enterprises for example, local government owned enterprises may become more popular for its higher risk insurance ability. Investors are willing to receive a lower investment return out of the consideration of risks. From the study, we can conclude that the COVID-19 affects the pricing determinants of green bonds significantly.

The extreme event of COVID-19 has caused huge volatility in China's capital markets. Therefore, it's important to take actions to stabilize the green bonds market and continue to develop green bonds. To achieve this goal, we can guard against financial market instability and external shocks. The bond market should also strengthen supervision. Strict standards could also be set to specify the definition of green bonds and regulate certification of green bonds.

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Big Data By Chenchen Zheng (Amily)

Introduction

Do you have a Facebook, Instagram, or Amazon account? Even if you haven't these firms have been gathering information about you right now. Have you ever noticed that your most current preferred goods are always uploaded on your own pages' platforms? At the very least, it's a regular occurrence among my peers and myself. That piques my interest. Is it true that these platforms are listening in on our conversations through the microphones on our devices? Perhaps it's just a coincidence from your perspective. In fact, they already have enough data on us to know who we are, so they don't need to acquire information from us in that way. It would be quite normal for these companies to track you on their own platforms using their own methods, but is your data safe with them? Where are they collecting your data from? What are they going to do with your data? How do they collect it? In this article, I would address the following questions: How do data scientists who work for companies such as Facebook, Instagram, and Amazon collect and use people's data, including their basic demographic information and interests?

Facebook

Facebook is a massive social media platform with over 2.9 billion members as of this writing in early 2022. A total of 1.73 billion users use the site on a daily basis. In a nutshell, it is one of the world's largest social networks. Anyone above the age of 13 who has a valid email address is eligible to join Facebook. It allows users to build free accounts, giving them the ability to communicate with relatives, friends, coworkers, and even strangers. Because of its widespread reach and large number of users, Facebook is able to gather data not only from a wide range of individuals, but also from a wide range of data itself.

Facebook does know almost everything about you, quite literally. At the moment you click "Agree to build" when you sign up, you grant these social media outlets permission to gather data about you. Facebook keeps a close eye on your Facebook profile, browsing data, behaviors on the platform, devices' settings, location, political preferences, finances, and the like, and gathers data about them. Do you believe this is the final chapter? You'd been dead wrong. Facebook actually has a lot more information than that. It not only has your information from when you use the platform, but also from what you've done outside of it.

To begin with, Facebook has access to anything you do on their platform. According to Facebook's research, most users are inclined to use their own account information such as their name, age, date of birth, email address, and even their preferred phone number. This is all the information Facebook can collect from you. Furthermore, the platform tracks every message, remark, and moment you send. By monitoring messages and communications between you and your "friends" on Facebook, it takes account of when and to whom you send chat messages, who you've befriended, and who has sent you friendship requests. The system may create specific categories about you by evaluating your networks of friends and people whose habits or interests are similar as yours, which is referred to as "stereotyping". Even the meta-data, the data about data, associated with any posts you make is tracked by Facebook.

However, these are just partial ways Facebook gathers data. It can also get data with many other methods. For example, the company monitors more technical data, extracted from your devices, from your surroundings, your transactions from other platforms, and your locations from data which they already have and images shared.

By collecting technical details, Facebook has access to a wealth of information about the devices you use, including programs loaded on your phone, operating system, device IDs, brand, available Bluetooth, Wi-Fi access point signals, and cell tower signals, and saves cookies among them. Moreover, the company may also track data from your devices' settings such as your time zone, IP address, language, internet speed, and devices that connect the same network as yours, which helps the platform know who you are living with. To my shock, Facebook even monitors your devices' actions. For instance, it may detect the movements of your mouse to determine how long you spend looking at a certain article or advertising, making it simpler for Facebook to go on to the next phase.

Whenever you use Facebook for financial payments, the website stores a considerable amount of information, including your account number, other card details, billing and shipping information, as well as account and verification details. With this data, Facebook is able to infer more data about you, such as your spending level, your lifestyle, the kinds of things you like and so on. In this way, it adds a whole new level of data about you to its database.

Around 80 percent of Facebook users use the network only through their smart-phones. Most individuals are probably unaware that by installing the Facebook app on their phone, Facebook would be able to track their whereabouts at all times. One of the easiest ways to find

out where you are is through GPS. As the company has access to your devices' data, it can properly monitor your GPS and hence know where you are. Then you might think: "If I turn off the GPS, it would not know where I am." That's not the case. As previously stated, Facebook has access to technical data from devices, which means it may utilize information such as Bluetooth signals, Wi-Fi hot-spots in your region, or your IP address to determine your specific position. Additionally, the platform may trace your real-time location from your devices' cameras. If you upload a photo on Facebook, your "friends" may not be able to tell where you are, but the platform does. That's because you have prioritized it in accordance with Facebook's privacy policies when you first sign up for your account.

So what is Facebook going to do with our data? Facebook can better target advertising by using location data. For example, if the website detects that you are a student, it may propose study-related products to you.

In 2012, Facebook submitted paperwork with the U.S. government allowing it to offer stock to the general public. It's worth at least $75 billion, according to estimates. Facebook, on the other hand, is selling its collection of private information - yours and mine - rather than selling specific items. Facebook earns profit by offering advertising space to organizations looking to reach out to us. Marketers select key words or information based on the data analysis. According to statistics, Facebook made $115 billion last year, which is a considerable number. Knowing your political beliefs in this scenario aids Facebook in determining which adverts would be most successful. Ads that appear on your screen may appear beneficial or, at worst, obnoxious. They are, however, much more. Your life's bits and bytes can readily be exploited against you. Everything you do will be recorded and may have an impact on your future.

The information gathered by Facebook may be used to feed photographs to face recognition databases and make advertising recommendations. Of course, there are several other applications for this data. According to PC World, Facebook has been working on face recognition technologies since 2011. When you tag someone in a photo on Facebook, it employs facial recognition technology to learn more about their appearance. Every time you submit a photograph of yourself, a colleague, or a close relative, you're training Deep-Face's AI to detect human face traits more accurately. This form of face recognition is quite invasive to one's privacy. If you post even one image on their platform, other people can find you very easily. Your photos could link to other information and make your identity vulnerable.

"The amount of data Facebook and the others have on us is absurd," says Jake Moore, cybersecurity specialist at Enjoy Safer Technology (ESET). Several Facebook users choose to hide their location from their page, oblivious to the fact that their every move is being tracked. However, as a matter of fact, you might be able to keep your personal information private from other users, but not from Facebook and some other social media firms. As a result, on Facebook, you have no privacy. Facebook follows your personal data on and off using a variety of methods and techniques, like App Tracking Transparency (ATT), Off-Facebook Activity, and cookies. That is to say even if you choose to hide your data from other Facebook users on the platform, Facebook itself still has access to that data - so you won't be able to hide any data from Facebook.

However, when it comes to data security, Facebook is not a corporation with a stellar track record. Facebook makes money mainly by selling tons of your data to other companies, and if asked, Facebook also makes data available to researchers, academics, as well as law enforcement authorities. Regardless of how Facebook has utilized your information, it has clearly been negligent in how it has shared that information with third parties. To make matters even more convoluted, Facebook now owns Instagram and Whats-App, and can pool some of the data it collects from those programs by sharing one prime database.

Instagram

Instagram is a popular photo-sharing social network and platform that is, like Facebook, available for free online. Users may utilize a smart-phone app to add descriptions and tags, post short videos and photographs, and share them with other users. It's an easy method to capture visual memories in everyday life, as well as travel, sports, family, and social occasions. Instagram, which is owned by Facebook, has about one billion users who use it every month on average and is one of the most popular and rapidly developing social media platforms in the world. Like with Facebook, if you look at Instagram's privacy and security settings, you will also find that the platform knows a lot about you.

Instagram is also able to identify when you are on Instagram, and tracks that information at any point in time. Even if you disable your privacy settings to prevent your location from being recorded, Instagram can still determine your exact coordinates based on GPS, Wi-Fi spots, and Bluetooth transmitters in your vicinity, a system that is the same with Facebook's. It may

also utilize what you see via your camera or in the backdrop of photographs to pinpoint your locations. The software compares all of your devices' technical data with a map program, and uses mathematical coordinates to spatially construct data

Instagram is able to gather a lot of data, like information on how users use the app on their phones, statistics on which accounts are linked to which devices, personal information such as text message history from devices, geographic information, address book contacts, or other comparable data, content that has been captured, account holders' names and passwords, user-generated data that connects them to the photographs they shot, tagged, or liked, and data on facial recognition. The software keeps track of your everyday activities and may permit others to do so as well. For instance, suppose you photograph your lunch one day and log on at the same time every day for several days. Then Instagram can figure out your basic schedule for the day. The app also has a feature that lets people know that you're active. As a consequence, not only Instagram itself, but also your "followers" on the app knows a lot about you.

Visiting shops, whether online or in person, may offer vital information on Instagram users. When it helps to better target advertising, the sort of goods you might be interested in buying. Instagram compiles all of the data on you in their databases. Instagram creates your profile based on the data you provide when you use their service. Your potential sexual inclinations, age, gender, and dietary preferences are all known to the platform. Instagram may know information about you that even your closest friends are unaware of. Because of the data, the app made a profit by selling data to third parties and offering advertisement spaces of roughly 90 billion dollars in 2019.

Instagram will also utilize the data they collected to optimize users' experience and research the human condition. The program assigns each user a label throughout the data collection process, which not only makes it simpler for the software to post adverts afterwards, and comprehend the world around us, it employs machine learning and large data. One hundred million Instagram photographs were utilized in one research to better understand worldwide dress patterns. Thanks to technological advancements. This research demonstrates how machine learning may aid in the extraction of insights while examining human, cultural, and social, economic issues all around the world.

Many social media companies, like Facebook and Instagram, will collect data not just from your activities and postings on their own platform, but also through their partners' and

friends'. The two applications' partners can also exchange information about you with the network – and this happens often. Any firm that works with them can contribute data to be included to the social media platform's database. Instagram admits to exchanging information with firms that were either linked with or part of the same group as them. This may be used to provide a more personalized and consistent experience across all Facebook products you use, regardless of where you use them.

You may frequently catch up with family and friends on what's new and what you're learning as part of your daily routine. Instagram is doing the same thing. Instagram hash-tags and Facebook likes are brought together to make a more comprehensive data collection of a specific user on the social media site. They may also link to third-party sites and compare data. All social media companies now have a more extensive database about you as a result of these practices. This will assist them form a more accurate version of you and assign you the appropriate label. Facebook's data on Instagram advertising is identical to its data on Facebook advertising. Consequently, anything you do on Instagram may result in advertisements appearing on Facebook, and vice versa. In this way, you must consider if you want your personal information in the hands of a third party.

Do you have the impression that Instagram is listening in on your conversations? You'll be flooded with recommendations on Instagram every time you converse to someone close to you about a topic you're currently interested in. In such cases, there is a sense that the platform is actually eavesdropping on users' conversations. To be frank, Facebook flatly denies listening to your talks using your device's microphone. Nevertheless, there are several reliable, recorded stories from individuals who show otherwise. Many people claim to be in the middle of a conversation regarding a product when they suddenly see it advertised. Although none of this has been proven, there are fears that social media may gain access to your device's microphone and listen in on conversations. It's all possible to be a bizarre coincidence. Even so, it might be a little unsettling for some users.

Instagram, not Facebook's main app, is said to be the most intrusive to users' privacy. The possibility that Instagram, as an independent social media tool, poses a challenge to Facebook's market dominance. According to pCloud's study, Instagram now stores 79 percent of its users' data and shares it with other parties, making it one of Facebook's largest ships in obtaining and marketing user data to advertisers.[13] Instagram is currently regarded as one of the most intrusive

programs for collecting user data. It has a monthly active user base of over a billion people. Instagram's role as a gateway for exchanging so much data about unknowing users is concerning. In fact, according to the investigation, Facebook, Instagram's parent corporation, is the second greatest offender when it comes to disclosing users' personal information. The corporation has given up 57% of its user data to third parties, which might include linked organizations.

Thus it can be seen that Instagram and Facebook collect and utilize a lot of the same data. However, there are some changes from the user's perspective. Instagram and Facebook vary primarily in that Instagram enables users to publish photographs and short videos, whereas Facebook allows users to share a variety of material, including photos, short and long videos, articles, website links, and quizzes. Furthermore, while Facebook has a greater readership than Instagram, Instagram is more popular among youth.

Amazon

Not only do social media networks capture massive quantities of user data, but so do other platforms like Amazon. Amazon is a global technology firm headquartered in Seattle, Washington, that specializes in cloud computing, e-commerce, digital streaming, and artificial intelligence. It has been called one of the world's most influential economic and cultural forces in the world, as well as the world's most valuable brand. It's an e-commerce behemoth that sells on digital marketplaces and has over 2.5 million active vendors. In the United States, its net sales were $280.5 billion in 2019.

Corporations all across the world gather our information whenever and wherever they can in order to preserve it for future use. When you browse on Amazon and buy a book, you may see a section on the website that says "Books you may like." You're not sure why Amazon thinks you'll enjoy these books, but you decide to go through them anyway. You could come across one or two books that you want to add to your shopping list. Based on data mining, which is the process of analyzing a large amount of data to uncover patterns, Amazon concluded that you would enjoy these books. Amazon acquired data from each user who bought the book you paid and looked at what other books they bought so they could promote them to you.

Amazon tracks data, including what you have witnessed, what you purchased, information about your website visit, how long it takes you to write your review, information about your remark (star rating, text, good/bad), your shipping address, phone number, and other

personal information, and information about Prime Membership (compare the online shopping experience of different user types), from users.

Most people don't read the privacy policy that outlines how the program uses your data since it's almost 4,400 words long. Amazon gets much of its data about you from three places, which are the data you contribute when you use Amazon (and its other services, such as reading Kindle books), the content it can acquire automatically (such as information about your phone and location), and the information it receives from third parties, such as Facebook, Instagram, Tweet, and the like.

Amazon obtains consumer data through its Alexa voice assistant, Audible audiobooks, Kindle e-reader, video and music platforms, e-commerce marketplace, home security cameras, and fitness trackers. In people's houses, Alexa-enabled gadgets record, and ringing security cameras catch each visitor. Every Alexa request, every Amazon order you place, every song you listen to on Amazon Music, and every Prime program you watch is monitored and saved. These records can show a person's basic information, like height, gender, weight, and ethnicity; his or her political leanings, whereabouts on any given day, and reading and buying habits.

Amazon provides virtual assistants with cameras and speakers, such as the Echo and Echo Show. We use it for a number of things, like obtaining daily news, weather updates, and environmental conditions. These speech recordings, according to the business, assist in improving Alexa's experience. It aids in the identification of speech from various client groups, resulting in proper message processing and functioning. However, it's possible that we aren't aware that these recordings are being stored on Amazon's servers, which means these devices are listening to our daily conversations. According to a reporter's dossier, Amazon acquired more than 90,000 Alexa recordings of family members from December 2017 to June 2021, an average of roughly 70 per day. The recordings included information such as the reporter's young children's names and favorite songs.

It also utilizes a collaborative filtering engine (CFE), which examines users' purchasing behaviors, ranging from previously purchased things to items in their shopping basket or wish list, goods they review and rate, and the most searched products. Not only that, if consumers select One-click ordering, Amazon assists them in purchasing things automatically. Further, in order to improve the speed of the purchasing process, the software anticipates what things consumers will purchase, so they are ready to ship as soon as the client asks it. Amazon employs

predictive analytics to increase retail transactions and net income while lowering shipping times and overall costs.

Metadata from other systems, such as Kindle, is also gathered by Amazon. It looks at highlighted words in Kindle on a regular basis to discover what readers are interested in. The software also utilizes this information to suggest more e-books to buyers and improves their reading experience.

Amazon not only aggregates massive quantities of data, but it also uses a variety of additional approaches, including offering dynamic prices, urging people to buy, screening of purchases and returning for possible signs of fraud, supplying chain optimization, managing distribution centers, alternating physical stores to infer that data and so on.

Until big data is used for pricing optimization, a product's price remains constant regardless of how often it is purchased on the site. Prices now fluctuate often. One explanation is the ability of big data platforms to determine a person's propensity to buy. According to statistics acquired before, Amazon is one corporation that regularly employs this dynamic pricing technique, adjusting the average product cost every 10 minutes. A study shows that the company's yearly income increased by 143 percent from 2016 to 2019 in this way.

With the debut of Amazon Personalize, the firm now offers developers an easy-to-use and expandable platform for making suggestions for consumers across a variety of categories. This lets other businesses leverage Amazon's technology to provide a variety of products to their customers, ranging from clothes to electronics. Amazon's income rises when clients are properly engaged through personalization possibilities and are willing to spend more.

The position of Amazon is a double-edged sword, since it makes it a target for retail fraud. Amazon addresses this issue by gathering over 2,000 historical and real-time data points for each order and employing machine learning algorithms to identify possibly fraudulent transactions. If someone refunds a large number of items in a short span of time, the computer will trace that individual to check if the reasons for the returns are genuine.

To cut delivery costs, Amazon's big data evaluates available data and chooses the warehouse nearest to the consumer or supplier. Additionally, graph theory aids in determining the ideal delivery schedule, route, and product grouping, lowering shipping expenses even further. The corporation also has a "fulfillment center" that forecasts what consumers are likely to buy and keeps track of remaining inventory.

Amazon Go is a store that uses big data to make decisions. Sensors in the shop can determine what items consumers are allowed to purchase, while cameras can verify that customers do not get an advantage through theft. Thus it can be seen that of these extra technologies, Amazon's data use and earnings have skyrocketed.

Because Facebook and Instagram are essentially social platforms, they have a lot of information on its users, from the individuals they engage with to the groups they belong to, and even their "private" messages (or so you thought). A lot of personal data is gathered, as it is with any social networking apps. Both companies claim to utilize it to customize and improve their own goods. They get the majority of their money from ads, therefore they naturally give them a lot of data.

Amazon is capturing your data and selling it to third-party marketplace retailers such as Starbucks, OfficeMax, Verizon, and Eddie Bauer. Amazon's business model differs significantly from those of social media businesses such as Facebook and Instagram. The bulk of Amazon's revenue comes from purchases made on their site, rather than money from ads unlike Facebook and Instagram. This is why Amazon is so lucrative. So, unlike social media, Amazon is collecting data for entirely different reasons. Amazon's objective is straightforward: to expand its service while also preventing fraud. Instead of collecting personal information about users, Amazon pulls more data from publicly accessible sources than social media firms. Essentially, if you don't want your information to be shared with other parties, Amazon allows you to opt out.

Conclusion

In this paper, I have described how these platforms acquire data. As you can see from the preceding paragraphs, these platforms really collect a significant amount of data from all of us. It is important to realize this and to understand how detailed, complicated, and intricate these procedures of data-collection are. They take place both on and off the platforms and are interconnected with each other. While Facebook and Instagram are social media platforms, Amazon often advertises through them. Furthermore, it's critical to understand how those processes function, as well as the types of data that the platforms collect from you, which, although related, are distinct. If you don't want your data gathered, you'll have to figure out a way to prevent it. The goal of this work is to take into account the role of data scientists and their responsibility for data security

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What Happens When A Plane's Engine Stops Working? By Xiyang Zhan

Abstract

This article discusses what happens to a plane if one or more of its engines gives out. The relevant lead-up explains the progress humans have made in aerospace technology and the resulting ability to fly complex machines around the world. But the main point is that major problems can still occur in light. Despite these, the paper aims to show that we find ways to troubleshoot and overcome even these with technological invention and human ingenuity.

Introduction

Technology is constantly evolving. Neanderthals were only able to move from one location to another on foot. However, it didn't take long, relatively speaking, before humans began to form complex societies with increasingly complex technological breakthroughs that changed the world. Sumerians invented the wheel in the fourth century B.C.[1]. The advent of seafaring ships 500 years ago helped globalize the world. Fast forward to the present and human beings are now sending people into space. The only limit to our technological capability is time.

Wilbur and Orville Wright invented the first successful airplane in Kitty Hawk, North Carolina in 1903. The advent of airplanes has made it possible since to travel to almost any location in the world within 24 hours. From "The Great Navigation Era," between the early 15th to the late 17th centuries, when seafaring Europeans explored regions across the globe, to the current age of commercial flights, , this development of transportation convenience has brought a qualitative change to people's lives by saving them the time, money, and energy that people used to need to travel much shorter distances. We can enjoy tulips in the Netherlands, fly to London to see Big Ben, and taste French desserts from local shops all within a few days because of airplanes. It is even possible to reach a vacation destination in the Caribbean within a few hours. Everything we take for granted was impossible 100 years ago, before the advent of commercial flying. As the narrator (Harrison Ford) says in Brian J. Terwilliger's movie "Living in the Age of Airplanes"[2]:

In the world we've made, everything is connected and nothing seems impossible. No virtual technology can ever do as the airplane does, it allows us to stay physically close to the people and places we love (Terwilliger, 2015, 44:12 - 44:30) The airplane is my top choice when it comes to long distance travel. I check the news about flying very often. From time to time,

there are reports about airplane crashes. Whenever I see these reports, I worry about flying safely. Not only are some crashes caused by the pilot, wild animals, weather, or mechanical errors, but also by single-engine failure. Still, the pilot, in these instances, has been able to land safely with only one engine. This makes me wonder whether that scenario was one-time luck for that plane. It also makes me wonder how many engines a plane *should* have that could support flying safely. So, in the remainder of this paper, I share my research about whether a plane can still fly if one of its engines gives out and how many engines a plane needs to fly safely and land in an emergency, without crashing.

I started by looking into the history of the development of airplane engines. Commercial airplanes used to have two to six engines,[3] with three-engine designs being the most common in the 1970s, globally. Even though more engines would seem to imply more power, they actually did not work as efficiently as in that theory. Nowadays, since more engines will consume more fuel and increase costs, most commercial airplanes have only two engines.

When engineers and designers design and build a commercial airplane, the most important principle is to ensure the safety of the plane. If two planes cost a similar amount of fuel to fly, but the risk factor of the lower-cost one is extremely high, no commercial company would likely fly with it. Therefore, if you choose to install several engines, the first guarantee is that the aircraft must be safe enough. And we already learned that if one engine of a twin-engine plane fails, it still could fly with only one other functional engine. But what if it was a four-engine plane? Can a four-engine plane still fly safely if three of its engines fail ?

Twin Engine Airplane

  For the first question, the news report only told us that the twin-engine plane was still working, but didn't explain why or how. I found out it is fairly common that a twin-engine plane can still fly with only one of its engines working. [4] This situation was considered when engineers first designed the structure of the twin-engine plane, and should work even when pilots take off and land with only one engine regularly as the standard practice. Pilots are also trained to fly with only one engine to be well-prepared to deal with this situation.[4] Actually, both engines of a twin-engine plane could be considered backups for each other. Thus, when one of them unexpectedly fails or seizes, the plane still has another engine as backup to support the whole flight. There are some small private jets that are lighter and designed with only one engine, but for regular commercial planes that carry a lot of passengers, a backup engine must be installed, which is the twin-engine design.

  Engines are installed on each side of the plane for twin-engine planes. Usually, they are beneath, above, or within each wing, or mounted on each side of the rear fuselage, close to the empennage.[5] If the left-side engine fails, the plane will lose balance due to the force of its thrust and will deflect to the right. Hence, the pilot or captain must adjust the rudder surface of the plane to offset the torque generated by a single-engine, which will decrease the difficulty of operating the plane by rebalancing it.[6]

Four Engine Airplane

But what about a four-engined plane? What if a four-engined plane had one failed engine? Do pilots need to land immediately, or can they continue flying with one engine down while the majority are still functioning properly? In 2005, this situation actually happened to a British Airways Boeing 747, which had four engines, and was flying from Los Angeles, United States to London, United Kingdom. Shortly after the take-off, the pilot found that one of the engines had broken down. To avoid a plane crash, the pilot reported the situation to the control center in London immediately and requested to land. But after discussion with the control center, the flight didn't turn back and continued flying to London, across the Atlantic Ocean, on the remaining three functional engines, even though it ended up consuming a lot more fuel using fewer engines. When the pilot realized the fuel was running low and the plane could not reach London's Heathrow Airport as originally planned, he requested an emergency landing at Manchester Airport. [7] So apparently, when one of the four engines is broken, the plane is still able to fly as normal, but requires more fuel to support the same distance route.

This led me to a second question: what about the inverse? While the Boeing 747 is still able to fly safely with three functional engines, what if the opposite happens? What if there is

only one engine working normally and the other three engines fail? Will the plane crash immediately? I checked flight accident records. In 1982, a British Airways Boeing 747 took off from London's Heathrow Airport, United Kingdom, bound for Auckland International Airport, in New Zealand. When the plane flew over the Indian Ocean, an incident occurred. The four engines of the plane stopped, one after another, and the plane descended rapidly from a height of 10,000 meters, as the pilot had lost track of the speed. If a plane power and can no longer maintain its proper altitude, it is no different from a glider. By that time, the whole plane was just gliding. The smell of death was in the air and everyone was panicking. But as long as the plane could get its power back, even a little, it would slow it from free-falling and would reduce the intensity of the impact. The captain was trying his best to remain calm and kept trying to contact the air traffic control center to attempt restarting the engine. When the engines of the plane stopped, the power supply system in the cockpit also stopped working, and the airspeed indicator completely failed. After failing six times to restart the engines, one of the engines finally restarted successfully on the seventh try. The plane climbed to an altitude of 5,000 meters with two recovered engines and landed on the runway safely under the command of the tower. [8]

When I was comparing these two incidents, I noticed that in both, the planes were able to fly with less than all of the engines *in the middle* of the flight route; in other words, once the planes were already off the ground. Now, you may also have some of the same questions as me: What if a plane is taxiing, and the speed is up but the plane hasn't left the ground yet, and suddenly one of the engines fails, can it still fly? Or does the pilot have to stop the plane immediately? There is the possibility that the plane will continue flying even when one of the engines is broken while taxiing, but it depends on if the plane has reached takeoff decision speed, which is also called V1. So before we further discuss this, I would like to share some important concepts about a plane's speed in the take-off phase of the plane.

When the plane accelerates to take off on the runway, whether it is operated by the pilot or the co-pilot, the flight system will report speeds of V1, VR, or V2 by voice. These are the key speeds when a plane takes off, and they are not random, but refer to the length of the runway, the load of the plane, the wind speed, the wind direction, and more. V1, the take-off decision speed, is the most important speed pilots use to decide if the plane can and will take off successfully.[9] If engine problems or other flight safety conditions occur *before* the plane reaches this speed, the pilot can choose to stop the take-off since the plane will have enough runway to break and come

to a stop safely. On the other hand, if the problem occurs *after* the plane accelerates to this speed, then the pilot must take off. Since the runway of the airport has a certain length, and the braking of the plane requires a certain distance to not overrun the runway, stopping after reaching V1 speed will cause an accident. It's safer to deal with the situation in the air.

V1 Speed

As long as the plane has reached the speed of V1, even if part of its engine is broken, the pilot is still requested to take off and handle the problems later. This is not just decided by pilots' and captains' experience or suggested by the airline companies. These are official regulations of the Federal Aviation Administration of the United States [10] for when engine failure happens. If it occurs *before* V1, the plane is generally stopped to take off and if it occurs *after* V1, planes usually continue to take off. But if it fails right at V1, the plane can continue to take off or stop the take-off, and there are three seconds to make the decision. All in all, to judge whether a twin-engine plane is able to take off when one of its engines fails depends on the specific time when it is broken. Either way, from the perspective of thrust, even a single-engine power system can still push the plane to fly.

In conclusion, if it is a twin-engine plane, when one of the engines fails during flight, it could continue, but it would be better to land soon. If it happens during the take-off phase, theoretically it can still take off, but it mainly depends on if it reaches speed V1. As long as it is still below speed V1, the pilot can step on the brakes. If it's a four-engine plane, it is not a big deal when there is only one broken engine; but when it has three broken engines, the plane will most likely crash. All these potential situations of a plane's power system have not only been considered in plane engine design, but also have specific protocols in place to clarify solutions to deal with potential accidents and mishaps. Each of our flight journeys is protected by a whole group of professionals and problem-solving engineers, who are working hard to minimize the risks to ensure you have a safe flight.

Conclusion

Accidents happen every day. Most of the time the pilots are able to adjust to the problem and get the plane back on the ground safely. A lot of this is due to the development of new aerospace technology. However, there have been tragedies that have cost hundreds of lives. For

now, if the plane is in the take-off phase and has a lower speed than take-off decision speed (V1) it can still fly. Considering the safety of all passengers, the pilot can choose to pause the flight. Generally speaking, if a plane's engines give out, it has a high chance to continue flying and land safely. But it totally depends on when the engines give out and what speed the plane is flying. Our biggest hope is that a plane, even if one or multiple engines give out, will always be able to still fly and land with no casualties. I hope you will enjoy your next flight!

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The Consequences Of The Industrial Revolution By Jordan Liu

Abstract

With the development of the steam engine, cotton gin, and other technologies, the Industrial Revolution transformed societies, economies, and environments during the 18th and 19th centuries. Entrepreneurs and business-owners introduced the factory system and forms of mechanized production in cities, while planters established colonial slave plantations to harvest raw materials for factories to manufacture into finished goods. Analyzing the perspectives of slaves, workers, and capitalists, this essay evaluates how beneficial the Industrial Revolution was. Although the Industrial Revolution was largely harmful for much of society and the environment, it profited the capitalist class tremendously and significantly raised the material wealth of industrial societies.

Keywords

Introduction

"The conditions of human life have not only been changed, but revolutionized within the past few hundred years," wrote the industrialist Andrew Carnegie (1889). The Industrial Revolution was "highly beneficial" for all of society, claims Carnegie, despite the vast wealth inequality between labourer and millionaire (1889). Yet, as a millionaire himself, Carnegie did not consider the perspective of groups among the labouring poor, such as slaves, artisans, and child-labourers, whom the Industrial Revolution had harmed. Although the Industrial Revolution significantly increased the rate of economic growth and enriched capitalists like Carnegie, the Industrial Revolution, which Enlightenment thought supported, was not universally beneficial but largely harmful, because industrial growth came at significant environmental, social, and human costs.

Discussion

Industrialization worsened the quality of life for most free workers and overseas slaves. The development of the cotton gin from 1790 to 1850 increased the profits of the American cotton industry and greatly expanded the supply of cotton goods, but this material growth came

at the expense of millions of African slaves forced to work on American cotton plantations. In 1851, an escaped female slave describes having to "bear the lash", being forced to plough and plant, and witnessing most of her children being "sold off to slavery" (Truth, 1851). The growth of the cotton industry very clearly harmed the quality of life for her and her children. Free children faced similar hardships. In 1909, the anarchist writer Emma Goldman wrote of America's "children", "sons", and "daughters" struggling in extreme poverty, referencing the widespread practice of child labour at the time (Goldman, 1909). Working families oppressed by debts and poverty had no choice but to commit their children to work to earn a living wage, even as many children lost limbs to factory machinery, developed lung diseases from mines, or were crushed to death in coal-breaking facilities .(Humphries, 2013) Similarly, in Britain, many children worked as chimney sweepers and swept chimneys with their bodies. The Romantic poet William Blake condemned this practice, since children would often suffocate to death in chimneys. Other Romantic poets like William Wordsworth lamented the loss of the natural landscape to expanding urban industries (Heller, 2011). In "The Excursion", Wordsworth describes urban industry as a corrupted version of nature, with "abodes of men" replacing the "trees" and the smog of factories replacing the "morning sun" (Wordsworth, 1814). A capitalist like Carnegie, who tends to focus only on wealth, could argue that industrialization raised material standards of living, as real wages gradually increased and a wider variety of goods, like potatoes, cotton, and sugar, became available due to industrial mass-production (Heller, 2011). However, most people would consider their material standard of living to be only a small part of their overall quality of life. Some may value environmental well-being as the most important factor to their quality of life; others may value their children or their access to certain rights and freedoms. Therefore, based on high child mortality rates, horrific working conditions, environmental degradation, and chattel slavery, one could argue that the quality of life for the majority of society actually worsened during the Industrial Revolution despite the improvement in material living standards.

In addition to diminishing the average quality of life, industrialization led to harmful social disruptions for traditional artisans, as mechanization and the factory system outcompeted the old methods of production. Unable to compete with industrial mass-production, artisans struggled to restore their former status by sabotaging their competitors' machinery. In England, handloom weavers repeatedly rioted against mechanization over the eighteenth century,

dismantling mechanical saw mills and the first spinning jennies (Horn, 2005). During the 1810s, several hundreds of weavers, dubbed "Luddites", destroyed mills and factory machinery. By wrecking machinery, these weavers attempted to maintain control of their relatively well-off livelihoods, instead of submitting to the poor wages and regimental working conditions of the factory system (Horn, 2005). In response, the British government deployed 12,000 troops to put down the Luddites and made machine-breaking a capital crime. The state executed hundreds of Luddites and sent hundreds more to Australia (Horn, 2005). Similar events were occurring on the continent. When Normandy began to adopt industrial machinery from England, artisans expressed concern that the machines would enrich a few industrialists but would practically enslave masses of people and leave artisans unemployed (Horn, 2005). During the chaos of 1789, woollen workers from Darnetal took action by destroying textile machines in Saint-Sever, while artisans dismantled and burned hundreds of spinning jennies. In 1825, hundreds of French workers shouted to the Mayor of Vienne (Pelz, 2016): "Down with the shearing-machine! Down with all machines!" Police and soldiers eventually suppressed the protest. In Silesia, the weavers used to enjoy relatively high status due to their specialised skill, until textile machinery rendered their skill obsolete and began to drive down their wages. As their wages threatened to deteriorate below subsistence levels, thousands of weavers revolted by destroying factory equipment and account books, before the Prussian government brutally repressed them (Pelz, 2016). All these cases echo a common theme: traditional artisans were trying to protect their status and livelihoods from the Industrial Revolution, but efforts at resistance were repressed by the state. By rendering artisanal skill worthless, industrialization destroyed old-established industries and forcibly declassed formerly esteemed artisans into the ranks of common workers.

Nonetheless, the Industrial Revolution benefited business-owners in particular and the economy, while the Enlightenment would eventually benefit all of society by granting natural rights (the right to life, liberty, and property). Writers across the eighteenth and nineteenth centuries observed how new methods of production had created an excess of wealth that could satisfy all of society's wants if distributed fairly. Prince Saunders advocated for giving "the labouring poor of the country a vested interest in the crops they raise, instead of leaving their reward to be calculated by the caprice of the interested proprietor" (Saunders, 1818). That way, the workers would enjoy their "proper portion of happiness" (Saunders, 1818). Saunders was writing in 1818 amidst the context of plantation slavery and the Haitian Revolution, but the issue

of how to distribute society's wealth continued to be relevant even after slavery. The capitalist Carnegie wrote that the problem of his age in 1889 was "the administration of wealth" (Carnegie, 1889). The anarchist Goldman seems to agree in 1909, as she calls America "rich enough to all her children with all possible comforts" but currently concentrates most wealth "in the hands of a few" (Goldman, 1909). The 1906 cartoon "From the Depths" illustrates this wealth inequality by depicting a group of workers struggling to hold up an ornate ballroom full of capitalists. By radically increasing economic output, the Industrial Revolution had the potential to ensure the well-being of all, but instead tended to benefit capitalists at the expense of workers. The distribution of legal rights by the Enlightenment was uneven as well, as male property owners enjoyed more rights than women or slaves. However, the Enlightenment indirectly influenced the abolitionist movement, which argued that slavery contradicted Enlightenment tenets on man's natural rights (Truth, 1851). Ironically, many Enlightenment thinkers supported slavery and responded that certain races were less human and thus ineligible for natural rights. Enlightenment ideals would also influence feminism, as women argued for legal equality on the same principle of natural rights (Truth, 1851). Even some socialists co-opted Enlightenment ideas to argue for reform or in some cases revolution: the socialist/anarchist thinker Goldman wrote that capitalist institutions violated the natural rights of workers. "life, liberty, and the pursuit of happiness" (Goldman. 1909). In short, the Industrial Revolution benefited the capitalist class by exploiting the labour of the working class, and although the Enlightenment initially justified forms of capitalist exploitation like plantation slavery, movements such as abolitionism, feminism, and socialism would eventually use the tenets of Enlightenment thought to secure more legal benefits for disenfranchised social groups.

Conclusion

Within a hundred and fifty years, the Industrial Revolution enabled the production of goods and the accumulation of wealth on a colossal scale, but at great human and environmental costs. The owners of industries benefited the most, but the Industrial Revolution's impact on the labouring masses of society was generally greater exploitation and misery, not universal well-being as Carnegie asserted. Industrialization wiped out the livelihoods of traditional artisans and subjected millions to chattel slavery to produce raw materials to be manufactured into finished goods. Meanwhile, the Enlightenment motivated some to justify the harmful impacts of

industrialization, while motivating others to advocate for universal rights. In short, the effects of the Industrial Revolution were beneficial primarily to the bourgeoisie and harmful for the rest of society; the effects of the Enlightenment were more complicated as the Enlightenment initially justified the harms of slavery, gender inequalities, and capitalism, despite eventually leading to the benefits of the abolitionist, feminist, and early socialist movements.

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"Annabel Lee" Poem Review By Jordan Liu

Edgar Allen Poe's poem "Annabel Lee" presents a special type of horror that I find much more engaging than flashy monsters. Poe explores the monster within: the human mind, twisted and corrupted into something horrific. In this way, the monster is "real" and compelling. Instead of quick jumps cares, the horror of "Annabel Lee" slowly creeps up on me, like a felt presence.

The poem sounds like a fairy tale until the ending. The narrator tells a story from "many and many a year ago" in "a kingdom by the sea", in which the narrator fell in love with a highborn maiden named Annabel Lee. A wind sent by angels chills her to death, and her kinsmen keep her body in a sepulchre. The narrator sleeps next to her in the sepulchre every night. This is when my vague unease turns into shock and disgust.

I realized that psychoanalysis, a critical theory learned from school, could be useful in a poem about the mind. Imagining myself as a psychiatrist interviewing the narrator, I read the poem again, noticing a deeper layer to the story. The narrator calls himself and Annabel Lee children. The word "child" may refer to a prepubescent boy or girl, but psychoanalysis does not interpret every element literally. Rather, a "child" could represent someone inexperienced or immature: an adult with childish qualities. I realized that Annabel Lee's "death" could represent a development from one mentality to another instead of corporeal death. The death of a child signifies growth from childish to mature qualities. Likewise, the chilling could indicate a transition from a passionate relationship to something estranged. Suddenly, the poem changes from a creepy fairy tale to an account of a breakup, in which Annabel Lee is alive but "dead" to the narrator.

With this understanding, I began to put together the rest of the puzzle. After the breakup, Annabel Lee returns to her family, the "kinsmen". The narrator expresses anger and depression, claiming that his love for her is stronger than the love of others. This suggests that Annabel Lee has found a new romantic partner, but the narrator has feelings for her and says that the angels in Heaven will not keep him apart. Angels could represent a moral compass, which the narrator has abandoned to pursue his love for Annabel Lee. His behaviour resembles that of an obsessive stalker.

Finally, the narrator addresses Annabel Lee as his "bride" at the end, but calls her a "maiden" at the beginning. This is a subtle contradiction. She obviously cannot be both married and unmarried. The narrator has deluded himself into thinking of Annabel Lee as his wife, when

the two never married and their relationship no longer exists. This correlates with the narrator's possessive attitude; he constantly addresses Annabel Lee as "my Annabel Lee" as if he owns her. Most works of horror become less intense on a second viewing. Yet, once I fully processed the character of the narrator, the horror of the poem felt stronger.

COIP By Sydney Rodin

Abstract

One in 40 children in the United States are Children of Incarcerated Parents ("COIP"). Of those children, roughly half are of the age of 10 and under. Studies have shown that oftentimes these children exhibit antisocial behavior, health problems, and an increased risk of suicide. One way in which these negative outcomes have shown to be minimized is through mentoring. Studies have investigated why types of mentors have had varying impacts on different COIP demographics. Factors just as age, gender, race, relationship length and relationship structure all play roles in results. Hour Children is a New York-based non-profit organization that works with and supports women and their families during and after incarceration. Their services include housing, childcare, mental health services, and, importantly, mentoring and tutoring to COIP. Through my volunteer work and interactions at Hour Children as a mentor/tutor, I was able to connect the real-world experiences I observed to the research that has already been done in the field. In my article, I synthesize the research on children with incarcerated mothers, mentorship targeted to them, and their schooling outcomes with my own experiences. Based on this, I found that the benefits of well-funded mentorship programs for COIP are well-documented and critical in creating better outcomes for this group of children.

Introduction

Children of incarcerated parents ("COIP") in the United States are an understudied population. The incarceration rate in the United States from 1978-2018 quadrupled, with nearly 1 in 100 adults in jail or prison (Stump et al. 1). This COIP sub-cohort of Americans has grown rapidly; according to research conducted by the Pew Trust the number of COIP increased by roughly 79% between 1991 and 2007 (Wiltz). In fact, more than five million children in the US are believed to have had a parent in state or Federal prison at some point in their lives (Cramer et al.). Depending on the source and definition, the current number of COIP ranges from 300,000 (Cho 257) to 1.7 million (Wiltz). Regardless of the exact number, understanding this population of children is critical for a number of reasons. First and foremost, COIP exhibit many negative outcomes tied to their parent's incarceration, ranging from educational struggles and anxiety to drug use and even their own incarceration (Stump et al. 164). Second, the way in which our current society handles mentorship for COIP, while greatly improved, still requires attention and funding to handle the increasing number of children in the population (Stump et al. 164).

Research has found many negative outcomes for COIP. Those are often broken down into two main categories: externalizing behaviors that can be seen by the outside world, or internalizing behaviors that more commonly describe a child's emotional or psychological state (Stump et al. 164). The list of negative outcomes is long for both external and internal behaviors. On the externalizing behavior side, some of the most commonly discussed behaviors are antisocial behavior, including conduct disorder, non-compliance, aggression, and minor delinquency. In many cases, these traits lead to problems later in life, specifically adult criminality (Stump et al. 164). In terms of internalizing behaviors, researchers have found low self-esteem and depression, which are believed to be associated with other stress-related health issues, such as asthma, nervous disorders, sleeplessness, and malnourishment, very common. (Stump et al. 164).

One outcome related to COIP that has, in fact, had material research performed is academic performance. Rosa Cho researched the relationship between these academic outcomes and what she terms "dosage," which is defined as "the length and frequency of the mother's separation from her child" (257). In other words, Cho set out to examine "how children's outcomes vary by the child's age at the time when the mother first enters prison or jail . . It also provides evidence on the ways in which those child outcomes vary by the length and frequency of the mother's incarceration" (258). Cho's research divided the study group by the development stages of the children when their mothers were incarcerated: middle childhood (ages 5-10), early adolescence (ages 11-14), and late adolescence (ages 15-17). Children in early childhood (ages 0-4) were not included due to a lack of data. One finding was that among children who experienced maternal incarceration between ages 5 and 17, early adolescent boys were the most likely both to drop out of school and to drop out due to their own incarceration (Cho 273). One suggested explanation for the discrepancy between the outcomes of girls and boys referenced studies which found that girls experience more internalizing behavior problems, which are not demonstrated by school drop-out, while boys tend to show both internalizing and externalizing factors (Cho 274). Furthermore, boys' dropout rates were more dependent on the frequency of maternal incarceration, while girls' likelihood of dropping out due to their own incarceration was sensitive to the length of maternal incarceration. Interestingly both boys and girls had better school outcomes as the frequency and length of maternal incarceration increased. Boys' dropout rates actually began to decline when their mothers had been incarcerated five times and remained

stable at a lower rate for boys with mothers incarcerated six or more times (Cho 274). With a number of caveats, Cho's research was extremely clear: there are many negative outcomes related to school and education for children of incarcerated mothers.

A question that naturally arises from these findings is how can society help these children and improve their outcomes. One possible solution is the implementation of mentorship programs. Mentorship programs have shown positive benefits to children with self-esteem issues, disabilities, and depression, particularly from those coming from low-income households (Lee et al. 2-3). Even more specifically, effective mentorship programs have been found to have positive impacts on educational expectations for COIP and relationships with their adult mentor (Stump et al. 163). Programs around the United States provide aid to these children via tutoring programs and mentorship of adult role models. Although tutoring and mentoring have many similarities, they vary; tutoring is solely focused on school, where mentoring may help with school but also offer emotional support and care.

Research performed in 2018 indicated that there are three main "enhancements" that can greatly improve these mentorship programs (Stump et al. 165). First, the program should have specific goals involving the COIP. This ensures that the mentor is working with the COIP on specific challenges that the individual may have, rather than a broad set of predetermined issues. This specific approach showed the most impact on the educational expectations of the COIP between them and their mentor (Stump et al. 170). In contrast, the success of those who did not have an incarcerated parent was most impacted by the age where tutoring began, due to the pressure and expectations not being as intense for younger children (Nickow et al.). The second enhancement is whether or not the program sought and received additional funding; the more funding a given program has, the more resources it is able to provide both the mentors and the COIP (Stump et al. 165). Also, tutoring and mentorship is costly, but there is a contrast in which tutoring resources are becoming more available as schools notice that such programs need to be implemented, but mentorship support for COIP is not getting the same amount of attention and resources (Nickow et al.). The third and final enhancement is mentor training, as the training can lead to longer, higher-quality relationships. Both the second and third enhancements discussed above lead to longer COIP/mentor relationships (Stump et al. 170).

In order to gain a better understanding of the existing research, one that was based on my own first-hand experiences, and gather my own observations, I decided that I would volunteer

with the School Fun after-school program that is offered by the Hour Children organization. Hour Children is a non-profit based in Long Island City, which focuses on children with incarcerated and formerly incarcerated mothers. The organization provides resources for both mothers and children including tutoring, mental health services, job application assistance, and shelter (*Hour Children*). The children go there after school from 2:30pm to 6:00pm, and they cook, do homework, play, read, and interact with other kids from ages four to sixteen who go through a similar experience. The program itself is situated in a large storage space where there are toys on one side of the room, a long table in the middle, and a makeshift kitchen on the opposite side with a small table and metal shelf filled with random kitchen appliances and ingredients. When I first visited, the four-year-olds were sitting in a circle playing with magna tiles. When I went to see what they were doing, I could plainly see their confusion and discomfort in my presence. Some, in fact, turned their backs to me, as if I weren't in the room. Keeping themselves in an enclosed circle, they effectively blocked me out, with an apparent discomfort and mistrust in their eyes as a new person was entering their space. This was expected once reading Cho's article analyzing the outcomes of children of having incarcerated parents. She states that COIP struggle during their young adolescents with low self-esteem, poor self-concept, and their development as an individual (260). Slowly, the children warmed up to me, but I still seemed very foreign to some. My third time visiting, a four-year-old asked me, "Why are you so white?" On the surface, I was not a natural mentor in their eyes, as I did not look physically like the adults with whom they had interacted in the past. Soon, however, the younger girls started to cling to me and wanted me to join in their game of family. Interestingly, all of them wanted to be the mother.

I tutored the same seven-year-old girl every time I went. I did math with her every time, and at the beginning it was evident that she was not comfortable around me: she would never look me in the eye, she would only use one word answers, and she used food (played with it in her hands, would shove a lot food into her mouth at once) as a way to distract from the conversation. She was answering questions such as "What is 97 + 4?" I tried showing her strategies, but it was obvious that they were not sticking. It took us almost an hour to get through a page of math, but by the end of it, she seemed to have gained confidence.

The next time I went, four-year-old girls were trying to jump into my lap, asking me to tie their shoes. Twelve-year-old boys were asking me to play checkers with them, and I knew then

that they had become comfortable with me. The girl whom I had worked with previously greeted me with a hug, and I brought her candy to eat while we did her work which made her eyes light up. Starting math, it seemed as though none of the strategies (drawing pictures, taking deep breaths, and taking a few minutes to try and talk it out on her own) had stuck since last week. She was hesitant with her work but quickly gained confidence, and I was so proud of her. For every question she got right, she gained more and more confidence. Her confidence was shown in both the excited tone in which she spoke, as well as in the enthusiasm she exuded waiting for the next question. This seemingly simple combination of giving strategies and importantly spending recurring time with the mentee showed the strength of the mentorship relationship.

During the time I was there, another older volunteer there was cooking for the kids. The kids raved that they cook there every day, with meals ranging from empanadas and pancakes to tacos. It was pancake day, and the kids were ecstatic, watching the woman's every move and always asking about the ingredients. When it was time to eat, the same twelve-year-old boys who had previously asked me to play checkers with them asked to set the table because, as one boy stated, it was what "normal families do." In the research, it is suggested that COIP feel as though with a parent gone, they have lost a sense of family and people whom they can look up to and be supported by (Stump et al. 164). By the kids coming together as a "family," many of these mentorship programs give them the sense of community and support that they may lack at home and/or school. The children call the head of the program "Aunty," and it is clear that they all regard each other as close friends and family - hugging every time they come in, helping each other with homework, and the older kids playing with the younger ones to ensure that they are entertained. These three-and-a-half hours at Hour Children allows these COIP to come together after school everyday and live as a big family.

While details vary by study, there is broad agreement that well-funded mentorship programs with highly trained mentors lead to more positive outcomes for COIP (Stump et al. 164). With that said, based on my own experience, there is far to go to create an infrastructure to more regularly and with more lasting benefit help COIP. The only way to effectively serve this population of up to 1.7 million children is through continued investment in programs. This investment is both financial and a commitment from administrators and mentors, all of whom require training to enhance the particular program. Evidence as to the effectiveness of the well-funded, well-resourced programs is confirmatory, and Big Brothers/Big Sisters and Hour

Children are just two examples of blueprints to maximize the positive outcomes of COIP. Yet, even those programs do not have sufficient resources to make a widespread, positive impact on COIP. Taken together, Big Brothers/Big Sisters and Hour Children received roughly $26 million in donations in 2019 (*2019 Annual Report* 13; *Hour Children*). Even if every one of those dollars were put toward mentoring programs (which is clearly not the case, and in fact only a small portion of those donations go toward such programs), that would equate to $11 per COIP if they were to serve the entire community of COIP. Furthermore, one study in 2018 noted that federal spending on mentoring programs ranged from $78-$90 million (Poon and Hagler) or roughly $50 per COIP. This compares to the $1,695 cost-per-youth-served quoted by MENTOR, a national mentoring organization (Garringer et al.). While these are clearly estimates, they get to an obvious point: the amount of financial resources required to have a far more meaningful impact on the lives of COIPs is far from where we stand today.

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Freedom Fights Infections: How the U.S. Government's Collaboration With the Private Sector Developed Penicillin into the Allies' Silver Bullet in World War II By Juliana Blazek

Introduction

Today, there is an easy solution for healing a scratch: placing a Band-Aid with an antibiotic right on the wound, knowing it will typically heal in a day or so. However, just this minor injury could be as deadly as a gunshot wound before the 1940s.[1] There is one explanation for this "miraculous" change in treating wounds: penicillin. In 1928, when Alexander Fleming first discovered penicillin in his culture tray in London, he failed to realize the significance of these spores that killed his growing bacteria (See Appendix A).[2] Ten years later, Howard Florey, a pharmacologist, took Fleming's discovery and started turning it into a practical antibiotic. In 1940, Florey and his team published their procedures and accomplishments in prominent medical journals catching the attention of scientists around the world amidst the crisis of World War II. With this new drug, wounded soldiers could use it to fight infections and heal quickly, resulting in fewer amputations and deaths. However, existing methods for producing penicillin only yielded enough for a few patients, so new methods needed to be created to successfully carry out mass production and supply it to the Armed Forces overseas. Accordingly, the U.S. decided to focus a part of its war time efforts on organizing this production by utilizing numerous government agencies to coordinate research and development through private companies and universities. The U.S. pharmaceutical industry's involvement in antibiotics began during this project on penicillin with the help of the U.S. Government's funding and encouragement of discovery. The work from scientists and other professions typically not involved in the war effort was another new and vital tactic for technological advancement in America, shaping a new postwar policy within the sciences.[3] With collaboration between government agencies and private companies and universities, the U.S. government strategically and effectively drove the

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[1] "The Discovery and Development of Pencillin," The American Chemical Society International Historic Chemical Landmarks, Accessed December 5, 2021, http://www.acs.org/content/acs/en/education/whatischemistry/landmarks/flemingpenicillin.html.

[2] Roy Porter, *The Cambridge Illustrated History of Medicine*. (Great Britain: Cambridge University Press, 1996).

[3] Daniel P. Gross and Bhaven N. Sampat, "Organizing Crisis Innovation: Lessons from World War II," (NBER Working Paper No. 27909, National Bureau of Economic Research, 2020).

mass production of penicillin to its armed forces, benefitting the soldiers and doctors on battlefield and ultimately facilitating the Allies' victory in World War II.

Before the Japanese bombed Pearl Harbor on December 7, 1941, forcing the U.S. to join the Allies in WWII, American scientists anticipated this day was coming. In June of 1940, a group of scientists met with President Franklin D. Roosevelt and proposed their idea of creating a National Defense Research Committee (NDRC), surmising that America was behind technological and scientific wise.[4] On June 27th, 1940, Roosevelt passed an executive order creating the NDRC with Vannevar Bush, former Vice President and Dean of Engineering at MIT, as head and his fellow leaders being Karl Compton, President of MIT, James Conant, President of Harvard, and Frank Jewett, President of the National Academy of Sciences and of Bell Labs. The NDRC was funded with Roosevelt's presidential budget and its goal was to perform research through collaborating and forming contracts with private companies, universities, and individuals. [5] A year later, on June 28th, 1941, Roosevelt expanded the NDRC by creating the Office of Scientific Research (OSRD). With the establishment of the OSRD, Roosevelt and scientists hoped the military problems the soldiers faced at war could be ameliorated through scientific research back in the States, so the leaders began prioritizing which military problems would receive the most attention and funding. Accordingly, the OSRD found willing and experienced researchers to experiment and solve the issues which arose while on the battlefield. Within the OSRD, further divisions emerged to focus on more specific issues, including the Committee on Medical Research (CMR) and the National Research Council's Division on Medical Sciences (DMS), which were the two associations working closely together on the research and production of Penicillin.

The CMR's mission was to find the medical researchers and facilities that could carry out research and experiments to solve wartime medical problems. Although there was an existing National Institute of Health (NIH) founded in the 1930s, the CMR was focused primarily on research. Such research focused specifically on meeting wartime needs rather than those medical issues presented previously.[6] The CMR was "a novel experiment in American medicine, for

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[4] Gross and Sampat, "Organizing Crisis," 1.
[5] Gross and Sampat, "Organizing Crisis," 4.
[6] Gross and Sampat, "Organizing Crisis," 6.

planned and coordinated medical research had never been essayed on such a scale."[7] The leaders of the CMR included President A.N. Richards, a pharmacologist and administrator at the University of Pennsylvania, who worked with the DMS to prioritize its work and evaluate the proposals of the different organizations and firms collaborating with it. These proposals were then read by the NRC and medical officers from the Army and Navy and ultimately were approved by Bush.[8] One of the ways that the CMR would determine the success or further issues with their experimentation regarding the health of the soldiers was to send its members onto the battlefields so they could experience firsthand what was needed in war. This further constituted the idea of the Armed Forces and government agencies such as the CMR working together to effectively survey the problems and find solutions. The CMR worked to develop protocols and guidelines for the private organizations, so these organizations had a set goal to reach. The individuals, specifically scientists, who agreed to help the government in the war effort had various motives; however, the American values of freedom and patriotism drove many to devote their time and efforts to further America's advancements on the battlefield.

Starting with the OSRD on down, the U.S. government leaders sought to utilize the best of American values to accelerate the development and mass production of penicillin that could help win the war. With more than 16 million U.S. soldiers fighting in WWII, almost every scientist knew someone who was drafted, and, thus, many wanted to help in the war effort.[9] The U.S. government sought to empower, not coerce, the private companies and universities through an approach that could be summarized using the acronym **F.R.E.E.D.O.M: F**unding supplied by the U.S. government providing critical resources to private companies and universities; **R**isk-taking was encouraged through innovation, problem-solving, and different approaches to the same solution; **E**nterprise as in utilizing the free enterprise system of profit incentives and private property with patents; **E**nergizing the private sector with a sense of urgency and deadlines; **D**iversity with inviting different individuals and private companies to take part in the effort; **O**bjective goals set by the government using competition among participating institutions to stimulate the best solution; and **M**anaged coordination of research, resources, and results.

[7] Chester S. Keefer, "Dr. Richards as Chairman of the Committee on Medical Research," *Annals of Internal Medicine* (Vol. 27, No. 8, pp.61-70)
[8] Gross and Sampat, "Organizing Crisis," 8.
[9] "Research a Veteran: How to Locate Someone who Fought in World War II," The National WWII Museum New Orleans, Accessed November 20, 2021, https://www.nationalww2museum.org/war/research-veteran.

With the decision to give this "freedom" of research, the OSRD established the Research and Development Contract which allowed for the flexibility in research and approaches while still having specific goals. This later helped with patents of this scientific work, giving private researchers incentives to do something for the public, while gaining their own private profits. These contracts allowed for large boundaries and limited micro-managing by the government over the researchers. [10] Furthermore, the OSRD created a friendly rivalry between institutions which incited them to partake in competitive research, providing a motivating factor for those to create a solution first.[11] This rivalrous approach was used in the research of penicillin for research programs focused on meeting the military needs through testing small batches of the drug. [12] Once organizations created their proposals, these were sent to the DMS where 33 committees composed of medical researchers would review the proposals and give feedback. These graded proposals were then sent to the CMR who would determine which ones would receive funding to proceed. The OSRD focused their funding on a set list of firms and universities and by the end of 1945 had spent over $536 million on 2,500 R&D contracts.[13] With freedom and incentives, participants were more willing to get involved with the war effort and contribute to the advances in technology, specifically with the penicillin project.

With infections posing one of the biggest threats for soldiers during the war, scientists were eager to find a method to heal these infections quickly and effectively. Penicillin seemed to be the best solution for this issue. Previously, in England when Fleming accidentally discovered the mold *Penicillium notatum*, he was unable to produce it in large enough quantities for human-testing and therefore gave up on it.[14] This mold was later pursued up by Howard Florey and Ernest Chain who again tried to produce it in larger quantities in the Oxford University laboratories and asked the British pharmaceutical companies to aid them in this. [15] However, with no help from the British government or companies, in 1941, Florey and his team decided to take their discovery to the U.S.[16] They met with Percy A. Wells, a U.S. Department of Agriculture

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[10] Hunter A. Dupree, "The great instauration of 1940: The organization of scientific research for the war," The twentieth-century sciences: Studies in the biography of ideas, (New York: W. W. Norton and Company, 1970).
[11] Gross and Sampat, "Organizing Crisis," 9.
[12] IBID.
[13] IBID.
[14] Gross and Sampat, "Organizing Crisis," 22.
[15] IBID.
[16] James Phinney Baxter, *Scientists against time,* Boston: Little Brown and Company (1946).

(USDA) administrator, who sent them to the USDA's Northern Regional Research Laboratory (NRRL) in Peoria, IL. [17] Here, Florey and his team met with Charles Thom, the principal mycologist of the USDA, and A.J. Moyer, director of the NRRL. Moyer suggested that researchers should attempt "submerged fermentation" which allowed the penicillin mold not just to grow on the surface of a pan in a thin layer, but rather in large vats.[18] In using these large vats, they eventually discovered the value of corn steep liquor which the U.S. had in large quantities since it was a waste product of the manufacture of cornstarch that was very popular in the mid-west and used it with the fermentation.[19] The process of fermentation included moving air throughout the tank and mixing it with an electric stirrer to aerate the tank, inducing the growth of large quantities of penicillin mold (See Appendix E). [20] The strain of penicillin that was used in this mass production was the strain *P. chrysogenum*, which was originally found on a moldy cantaloupe at a farmer's market in Peoria and produced six times the amount of natural penicillin than Fleming's original strain did. [21]

In addition to the USDA, A.N. Richards with the CMR also promised Fleming they would "see that everything possible was done to expedite the production of penicillin." [22] While Fleming presented a way to produce natural penicillin and wanted to mass produce it, the CMR also tried to develop synthetic penicillin and mass produce that instead. With this other synthetic approach, people were unsure about the practicality of Fleming's "natural" way, and both Richards and Bush thought synthetic would be easier, technologically and production wise. [23] These two approaches had different problems that needed to be researched and solved, requiring the CMR to simultaneously fund two different R&D programs. While the synthetic program required further research to be done on how to manipulate penicillin's molecular structure, the natural approach only needed a method to mass produce it.

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[17] Conniff, "Penicillin Wonder Drug of WWII."
[18] Robert Gaynes, "The Discovery of Penicillin – New Insights After More than 75 Years of Clinical Use," U.S. National Library of Medicine. Published May 2017, Accessed November 21, 2021, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5403050/.
[19] IBID.
[20] IBID.
[21] IBID.
[22] Federal Trade Commission, Economic Report on Antibiotics Manufacture, No. 414: Government Printing Office (1958).
[23] Gross and Sampat, "Organizing Crisis," 23.

The natural versus synthetic approaches to producing penicillin displayed how American innovation and competition led to the fastest, most efficient outcome. While the synthetic method initially seemed more feasible to scale into large production, the natural method ultimately proved to have the easiest production with the fermentation technique. With the natural approach, the CMR's role differed from providing funding for the project itself but rather persuading pharmaceutical companies to become involved and use their own resources. While the CMR did provide a small sum of funding to the NRRL for research, in 1941, the CMR met with pharmaceutical companies such as Merck, Squibb, Pfizer, and Lederle Labs to ask them to invest in the production development of penicillin.[24] However, some of the firms such as Merck and Pfizer were skeptical of the project's profit potential at first, so the CMR gave these firms information and reports to facilitate the collaboration between them. [25] Another organization that worked with the CMR and these firms during the project was the War Production Board (WPB) as it supplied the firms with equipment and connections to academic institutions which could provide a research facility and evaluate the samples of penicillin produced. However, the firms ultimately had to mostly fund themselves but were inspired by the incentive of helping their country, their own reputations as innovative companies, and the profit potential (See Appendix F). [26]

In 1942, the companies were producing around 40 million units of natural penicillin monthly (only enough for about 40 patients since it took approximately one million units of penicillin to treat one patient).[27] This meant penicillin was still being produced in small quantities, necessitating further research and testing to be conducted in an organized and timely way. The CMR, along with the NDRC, headed the testing by giving samples of penicillin to hospitals for free in exchange for case results about each patient that was given the drug. [28] As penicillin production grew, so too could the testing realms. In addition to testing in the States, the CMR began testing at the battlefields on wounded soldiers. [29] With inspiring results from the battlefield, there was now a definite need for large-scale production facilities which could

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[24] Gross and Sampat, "Organzing Crisis," 23.
[25] Gross and Sampat, "Organizing Crisis," 24.
[26] IBID.
[27] Baxter, *Scientists against time*.
[28] Gross and Sampat, "Organizing Crisis," 24.
[29] Edwin Cowles Andrus, *Advances in military medicine, made by American investigators*, Vol. 1: Little, Brown and Company (1948).

produce enough penicillin to be sent to American troops overseas. The CMR worked with the WPB's Office of Production Research and Development to procure the materials, some funding, and technical expertise, in addition to the Defense Plant Corporation which helped with the construction of facilities. [30] The WPB played a vital role in sharing information between the private firms and in funding research for successfully scaling up the production of the drug. Eventually, natural penicillin production grew from 425 million units (treating 425 patients) monthly in June of 1943 to 117.5 billion in June of 1944 to 650 billion (treating 650,000 patients) in June of 1945. [31] By 1945, there was then enough penicillin for not only U.S. and other Allied troops, but also for civilians at home in the States.

While America was becoming very successful in the production of penicillin which ultimately helped save many troops from infections, Germany, on the other hand, lacked the F.R.E.E.D.O.M values to motivate the same level of production in its country. When Florey's practices and procedures were published in the *Lancet*, German researchers became increasingly aware of the benefits of penicillin and started seeking access to Florey's strains of the drug. From then on, the published works of British and American scientists were strictly controlled, hoping to reduce information from falling into the hands of the Germans.[32] However, despite such efforts, the Germans learned of the Americans' techniques such as the use of corn steep liquor to produce greater quantities of penicillin. With most of their technology and research based off the British and American developments, some German researchers found a fascination and began conducting their own research. Gerhard Domagk, a German pathologist, had previously developed sulfa drugs which were used in the early years of WWII to help control and treat respiratory diseases.[33] The sulfa drugs did not work as well in combat as penicillin did and Colonel Elliott Cutler, the U.S. Army's chief surgical consultant in the European theater, wrote in May of 1943 how sulfa drugs "did not keep infection away from wounds" and couldn't confidently assure people that these drugs actually helped save soldiers' lives.[34]

The Nazi regime also created a strict and forced environment and, instead of giving out incentives and inspirations, they instilled fear into their workers if such was needed in achieving

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[30] Baxter, *Scientists against time*.
[31] Gross and Sampat, "Organizing Crisis, 25.
[32] Gilbert Shama. "Pilzkrieg: the German Wartime Quest for Penicillin." *Microbiology Today*. Vol. 30 (August 2003).
[33] Conniff, "Penicillin Wonder Drug of WWII."
[34] Conniff, "Penicillin Wonder Drug of WWII."

a goal. [35] With their lack of respect for private property, the Nazis failed to encourage private companies to willingly join the war effort, take innovative risks, and conduct new research into antibiotics, especially since they already had sulfa drugs.[36] In Germany, private companies could retain profit from their findings, yet these were controlled on the government's terms, while private companies were frequently threatened through nationalization by the government. [37] Hitler and his regime further discouraged scientists by preventing scientists from receiving recognition for their works; for example, Hitler prohibited German scientist, Richard Kuhn, from accepting the Nobel Prize in 1938 for his work on vitamins. [38] Unlike in the United States where the WPB mainly headed the penicillin project and mobilized the fermentation industry involving twenty-one private companies, Germany had only three companies, IG Farben, Schering, and Merick, which were the main participants in work on penicillin.[39] Furthermore, there was not a main laboratory in Germany that created a systematic approach to research and production with penicillin, making German microbiologists unable to effectively share their knowledge and determine which penicillin strains were the most productive. [40] Without central coordination, there was also a lack of funding in Germany; the cost of the penicillin program in the United States was around $14 million dollars and although there is no data for the amount of money put towards penicillin in Germany, Richard Kuhn only received around $10,000 for research on antibacterial drugs.[41] Without motivation, resources, and free enterprise, German scientists failed to match the magnitude of collaboration that orchestrated the penicillin project in the United States.

When D-Day arrived in June of 1944, the United States had manufactured enough penicillin to treat all the wounded Allied soldiers during the invasion. [42] Penicillin was administered to soldiers either by applying it on the battle wounds as a powdered version or

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[35] Christopher Buchheim and Jonas Scherner, "The Role of Private Property in the Nazi Economy: The Case of Industry," *The Journal of Economic History* 66, no.2 (2006):390-416. doi:10.1017/S0022050706000167.
[36] IBID.
[37] IBID.
[38] IBID.
[39] IBID.
[40] IBID.
[41] IBID.
[42] "Medicine's Manhattan Project," *MIT Technology Review*, Published July 1, 1999, Accessed December 8, 2021, https://www.technologyreview.com/1999/07/01/236632/medicines-manhattan-project/.

through a drip, using a needle.[43] Soldiers carried penicillin with them in cases that included the syringe with penicillin, so they could apply it to themselves when they were wounded or when a medic was not available. In terms of battle diseases, penicillin was used mainly in combatting gangrene, a disease in which tissue dies because of a lack of blood supply, and septicemia, blood poisoning from bacterial infections.[44] Among the Allied troops, using penicillin, there were only about 1.5 cases of gangrene per thousand and soldiers then died from gangrene half as often as they did previously in the war; however, without penicillin, the Germans had 20 to 30 gangrene cases per thousand.[45] Furthermore, by treating wounds with penicillin, doctors could reduce the treatment time for patients, preventing the spread of bacteria, lessening the need for amputations, and allowing the soldier to return to fight. Medics could simply clean up the wound, sprinkle it with the powdered penicillin, and wait for the patient to recover with daily penicillin injections (Appendix H).[46] Images started getting sent back to the States and made into inspirational posters showing medics giving penicillin to soldiers, adding to the people's views of the "miraculous" effects of this drug (See Appendix I). In now knowing that a minor wound might not kill a soldier in battle, with this new drug, soldiers' morale was boosted, encouraging them to keep fighting. As a result of the development of penicillin and other medical improvements, the survival rate of American men wounded in battle increased from 4% in WWI to 50% in WWII. [47] By the conclusion of WWII in 1945, the United States had produced 6.8 million doses of penicillin that year and eventually removed all restrictions on its availability, allowing U.S. citizens to purchase it at their local pharmacies. [48] In wars following WWII, such as the Korean

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[43] Robert Bud, *Penicillin: Triumph and Tragedy*, United Kingdom: Oxford University Press, 2007.

[44] Conniff, "Penicillin Wonder Drug."

[45] IBID.
Although the Germans had some penicillin from the strains they scavenged from Florey, they were unsuccessful in mass-producing the drug and therefore did not have enough to give to their military; however, Hitler's personal physician, Theodor Morrell, was able to obtain a quantity of penicillin from a captured Allied soldier and gave it to Hitler, saving his life after receiving injuries from a bombing.

[46] Conniff, "Penicillin Wonder Drug."

[47] David Vergun, "Medical Improvements Saved Many Lives During World War II," U.S. Department of Defense, Published March 17, 2020, Accessed December 8, 2021, https://www.defense.gov/News/Feature-Stories/story/Article/2115192/medical-improvements-saved-many-lives-during-world-war-ii/.

[48] "The Discovery and Development of Pencillin," The American Chemical Society International Historic Chemical Landmarks.

War, penicillin continued to be effective as it was used in large doses to fight the bacterial infections of *Clostridium* species that soldiers were contracting while in East Asia.[49] With the medical effects of the drug still being useful to this day, the lessons and values employed between the U.S. Government and private companies and universities during the penicillin project remain just as important. When the COVID-19 Pandemic struck the United States in March of 2020, the U.S. government created Operation Warp Speed (OWS) to rapidly develop a vaccine. COVID-19 required science, technology, and innovation to be implemented though diagnostic tests, contact tracing technologies, and molecular models to understand the disease and create ways to combat this crisis quickly and effectively.[50] Paralleling the OSRD's approach to penicillin and using the F.R.E.E.D.O.M principles, OWS brought together government agencies, such as the NIH, Food and Drug Administration (FDA), and Centers for Disease Control and Prevention (CDC), the military, and eight pharmaceutical companies.[51] These companies had different approaches which included new technologies such as mRNA (Moderna and Pfizer/BioNTech), live-vector (AstraZeneca, Johnson & Johnson), recombinant-subunit-adjuvanted protein (Novavax, Sanofi/GSK), and live attenuated virus that would be given orally (Merck).[52] Dr. Slaoui, leader of the OWS, encouraged these approaches by setting objectives within the companies, ensuring deadlines were met quickly, and agreeing to pre-purchase doses of vaccines without FDA approval.[53] OWS was created into an eight-month, $18 billion partnership to bring 300 million vaccine doses to the American people on an

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[49] W.G.P Eardley, K.V. Brown, T.J. Bonner, A.D. Green and J.C. Clasper, "Infection in conflict Wounded," U.S. National Library of Medicine, Published January 27, 2011, Accessed December 9, 2021. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3013428/.

[50] Daniel P. Gross and Bhaven N. Sampat, "Crisis Innovation Policy from World War II to COVID-19," Cambridge: National Bureau of Economic Research, June 4, 2021.

[51] Gross and Sampat, "Crisis Innovation Policy," 16.

[52] Gross and Sampat, "Crisis Innovation Policy," 17-18.
During WWII and with the production of penicillin, the United States wanted to restrict penicillin research from the Germans. Ironically, in response to COVID-19, U.S. company, Pfizer, and German company, BioNTech, worked together and shared their information to produce a vaccine together.

[53] David Shulkin, "What Health Care Can Learn from Operation Warp Speed," NEJM Catalyst, Published January 21, 2021, Accessed December 13, 2021, https://catalyst.nejm.org/doi/full/10.1056/CAT.21.0001.

emergency-approved basis.[54] Whether it is the 1940s or 2020s, when the U.S. uses its talents and resources to collaborate with a common goal, its citizens are capable of reaching prolific developments that aid the world as a whole.

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[54] Paul Gregory, "Getting the facts right on Operation Warp Speed," *The Hill*, Published March 20, 2021, Accessed December 11, 2021, https://thehill.com/opinion/white-house/544175-getting-the-facts-right-on-operation-warp-speed.

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Differential Impact of Dyslipidemia on Chronic Kidney Disease Between Men and Women

By Jay Dalal

Abstract

Dyslipidemia (DLD), defined as an imbalance of lipids in the blood, is proven to have a strong association with chronic kidney disease (CKD). CKD is more frequent in women than men, although men are more likely to progress to severe stages. Whether sex differences drive the effect of DLD on CKD severity remains unclear. In this study, the relationship between biological sex and CKD severity was investigated by parsing the public electronic health records of 491 CKD patients in Abu Dhabi. Sex-specific relative risks (RRs) were calculated using a history of DLD as a risk factor for severe CKD (stages 3 - 5). The RR was 2.98 (95% CI: 1.78 - 4.18) in women and 2.86 (95 CI%: 2.02 - 3.70) in men. Smoking was identified as a confounding variable because it has a higher incidence in men and a known negative impact on CKD. Thus, we validated the findings in a subsetted group excluding any patient with a history of smoking: the RR was 2.96 (95% CI: 1.76 - 4.16) in women and 2.61 (95% CI: 1.57 - 3.65) in men. These results indicate that, among CKD patients, women with DLD are more likely to progress to severe stages of CKD than men with DLD. The excess risk may be explained by notably higher rates of obesity in women and the idea that women have poorer adherence to DLD medications, although this is newly discovered evidence. Future studies are needed to investigate mechanisms behind this observed disparity.

Introduction

Chronic Kidney Disease (CKD) is defined by persistent renal structural abnormalities (e.g. cysts, tumors, atrophies, malformations, etc.) lasting longer than 3 months, leading to progressive loss of kidney function [1]. As a constantly increasing burden, due to considerable variety in risk factors, effect on 850 million people annually, and status as a strong risk factor for coronary artery disease [1], CKD presents a substantial clinical and public health issue. Therefore, developing a deeper knowledge about contributing factors to CKD pathogenesis and progression is instrumental to personalized care.

Dyslipidemia (DLD), defined as abnormally imbalance amounts of lipids, has a multifaceted but strong contribution to CKD development [2], mortality [1][2], progression to

more severe stages and end-stage renal disease [3], and cardiovascular disease [3]. Lipids are absorbed from the intestines and used for a plethora of functions: energy, steroid production, bile formation, etc. DLD develops primarily due to increased triglyceride levels, decreased levels of high density lipoprotein (HDL-C), and varying levels of low density lipoprotein (LDL-C), all of which are factors critical to the pathways that absorb and utilize lipids [4]. The abnormal metabolism of these lipids and other CKD-related modifications of lipid particles promotes atherogenesis, inflammation, and endothelial cell dysfunction [1][6].

DLD plays an important role in understanding CKD physiology due to its high prevalence among DLD patients. In a 2002 study on more than a thousand patients on hemodialysis (a method that utilizes machinery to purify blood), only 20% had balanced and healthy lipid levels (LDL < 130 mg/dl, HDL > 40, triglycerides < 150). Additionally, of 317 patients on peritoneal dialysis (a method that utilizes the lining of the stomach as a natural filter to clean blood), 15% had normal lipid levels [12]. A larger study discovered that, out of more than 21,000 patients on dialysis, there was an 82% prevalence of dyslipidemia [12]. The National Kidney Foundation recommends that adolescents and adults with CKD be screened for DLD regularly using the standard fasting lipid profile, which measures total cholesterol, LDL-cholesterol, HDL-cholesterol, and triglycerides [6].

As CKD progresses, DLD often worsens: a National Health and Nutrition Examination Survey (NHANES) from 2001-2010 concluded that the prevalence of DLD increases from 45.5% in patients with CKD Stage 1 to 67.8% in patients with CKD Stage 4. Additionally, use of lipid-lowering medications, which treat DLD, increases from 18.1% in patients with CKD Stage 1 to 44.7% in patients with CKD Stage 4 [5]. Nevertheless, the true nature of DLD pathogenesis and its physiological effects on CKD remains unknown [6].

Numerous studies suggest that CKD is more prevalent in women than men, although men are more likely to progress to end-stage renal disease (ESRD) [7][8][9]. Nonetheless, clinically meaningful sex differences regarding the relationship between DLD and CKD, which could provide paradigm-changing insight on CKD-related DLD pathogenesis and management of DLD in patients with CKD, remain uncertain.

In this study, an analysis was conducted on an Abu Dhabian dataset to evaluate how links between a clinical history of DLD and severity of CKD differ between men and women [10].

Methods

The electronic health records obtained for this study are from an open-access, public, and free dataset titled "Chronic Kidney Disease EHRs". This dataset describes an observational study of 491 patients whose data was collected at Tawam Hospital in Al-Ain city (located in Abu Dhabi) between the 1st of January and 31st of December 2008. The cohort was made of 241 women and 250 men, with an average age of 53.2 years.

The data included 22 clinical variables, specifically demographics, physical conditions, a history of potentially relevant diseases, disease-specific medications, and results from clinical laboratory tests. According to the standards of Tawam Hospital, every patient included in the study was at risk for cardiovascular disease. Besides subsetting to make comparisons, no other manipulations were made to the data. Further information about the dataset can be found at the original article [10].

This study was conducted to assess how the impact of DLD in CKD progression differed between men and women. We used EventCKD35, a binary variable, to measure CKD severity. The estimated glomerular filtration rate (eGFR) baseline, which was collected by blood test and measures kidney function, was measured as a clinical variable and traditionally plays a key role in CKD staging definitions. An EventCKD35 value of 0 indicates that the CKD was at stage 1 (normal kidney function) or 2 (mild CKD), meaning that the true eGFR was ≥ 60. EventCKD35 of 1 indicated that CKD was at stage 3 (moderate CKD), 4 (severe CKD), or 5 (extreme CKD and kidney failure), meaning that the true eGFR was ≤ 59.

DLD was defined by a serum thyroglobulin (Tg) ≥ 2.26 mmol/L, a serum total cholesterol (TC) ≥ 6.21 mmol/L, or when the patient was taking lipid-lowering medications [10]. The sex variable was reported in binary format of male or female [10].

For the cohort presented, we calculated sex-specific Relative Risks (RRs) for patients with a history of DLD versus those with no history of DLD. Our defined risk factor was having a history of DLD, the positive outcome being an EventCKD35 of 0 and the negative outcome being an EventCKD35 of 1 (Table 1).

Upon preliminary calculations on demographics and baseline characteristics of male and female patients, a history of smoking was identified as a confounding variable. In addition to worsening lipid imbalances and thus, increasing prevalence of dyslipidemia, including patients with a history of smoking, was proven to increase prevalence of other related conditions, such as

coronary artery disease and hypertension [11]. Of the 75 patients with a history of smoking, there were 2 women (0.8% of all female patients) and 73 men (29.2% of male patients), presenting a wide sex-based disparity. For this reason, separate calculations for RRs for both a dataset with smokers and a subsetted dataset without smokers were performed to highlight the influence of a history of smoking on the results.

Table 1. A 2x2 contingency table representing allocation of variables (a, b, c, d, and n) under which sex-specific calculations of Relative Risks (RRs) will be made.

	History of DLD	No History of DLD	Row Total
CKD Stages 3, 4, or 5	a	c	a + c
CKD Stage 1 or 2	b	d	b + d
Column Total	a + b	c + d	n

The Cochran-Mantel-Haenszel (CMH) test was performed to account for the binary nature of the predictor and outcome. Cases were stratified into two categories depending on sex. The strata-specific RR was calculated according to the equation (1), where a, b, c, d are the corresponding values in Table 1.

$$RR = \frac{a/(a+b)}{c/(c+d)} = \frac{a(c+d)}{c(a+b)} \tag{1}$$

The weighted average across both the strata of male and female patients was calculated using equation (2) to provide a sex-independent relative risk for the entire patient population. This calculation was performed with the intention of providing a summarizing statistic of the dataset used in this study. This allows a comparison of results from this study to further studies examining the link between dyslipidemia and CKD.

$$RR_{cmh} = \frac{\sum \frac{a_i(c_i+d_i)}{n_i}}{\sum \frac{c_i(a_i+b_i)}{n_i}} \tag{2}$$

With a_i, b_i, c_i, d_i, and n_i representing the a, b, c, d, and n values, respectively, for the ith stratum (Table 1). The 95% Confidence Intervals (CI) were calculated according to equation (3)

$$RR \pm 1.96 * \sqrt{\frac{1}{a} + \frac{1}{c} - \frac{1}{a+b} - \frac{1}{c+d}} \qquad (3)$$

R version 4.2.0 was used to analyze the data.

Results

Of the 491 cases in the original cohort, 416 were identified and had no reported history of smoking. Of the 75 smokers, many more were male (n = 73) than female (n = 2), presenting smoking as a confounding covariate. The median age for all patients was 53.0 years (SD: 13.82): 52.7 years (SD: 15.30) in males and 53.8 years (SD: 15.3) in females. Figure 2 includes the demographics, medical history, disease-specific medications, disease timings, and results of clinical/physical tests of all patients in the cohort, including smokers.

The RR of severe CKD in all women was 2.98 (n = 241, 95% CI: 1.78 - 4.18) while the RR of severe CKD in all men was 2.86 (n = 250, 95% CI: 2.02 - 3.70). The overall RR of all patients was 2.87 (n = 491, 95% CI: 2.18 - 3.56).

Subsetting the data to exclude patients with a history of smoking changed the results as follows: the RR of severe CKD in all non smoking women was 2.96 (n = 239, 95% CI: 1.76 - 4.16) while the RR of severe CKD in non smoking men was 2.61 (n = 177, 95% CI: 1.57 - 3.65). The overall RR of all non smoking patients was 2.73 (n = 416, 95% CI: 1.95 - 3.52) (Figure 3).

Figure 2. Baseline characteristics and results of clinical and physical tests for all patients in the cohort (n = 491). Numerical data is presented as mean $\pm$ standard deviation while binary data is presented as the number of positive cases with percent of positive cases in the total number of cases per category in parenthesis.

Characteristic	Overall (n = 491)	Male (n = 250)	Female (n = 241)
Age — year	53.2 ± 13.8	52.7 ± 15.2	53.7 ± 12.1
Comorbidities — no. (%)			
Diabetes Mellitus	215 (43.8)	116 (46.4)	99 (41.0)
Coronary Heart Disease	45 (9.2)	33 (13.2)	12 (5.0)

Vascular Disease	29 (5.9)	22 (8.8)	7 (2.9)
Smoking	75 (15.3)	73 (29.2)	2 (0.8)
Hypertension	335 (68.2)	172 (68.8)	163 (67.6)
Dyslipidemia	317 (64.6)	159 (63.6)	158 (65.6)
Obesity	248 (50.5)	101 (40.4)	147 (61.0)
Medications — no. (%)			
Dyslipidemia ‡	271 (55.2)	134 (53.6)	137 (56.8)
Diabetes Mellitus	161 (32.8)	92 (36.8)	69 (28.6)
Hypertension	303 (61.7)	153 (61.2)	150 (62.2)
ACE Inhibitors or Angiotensin Receptor Blockers	219 (44.6)	124 (49.6)	95 (39.4)
Total Cholesterol (mmol/L)	5.0 ± 1.1	4.8 ± 1.1	5.1 ± 1.1
Creatinine (µmol/L)	67.9 ± 17.9	79.0 ± 16.0	56.3 ± 11.7
eGFR Baseline*	98.1 ± 18.5	95.6 ± 20.6	100.8 ± 15.6
Systolic Blood Pressure (mmHg)	131.4 ± 15.7	132.0 ± 15.7	130.7 ± 15.7
Diastolic Blood Pressure (mmHg)	76.9 ± 10.7	77.6 ± 11.3	76.0 ± 10.0
Body Mass Index (BMI)	30.2 ± 6.2	28.7 ± 5.8	31.7 ± 6.3
Number of Months since severe CKD-related event or previous	83.0 ± 26.0	78.4 ± 30	87.9 ± 20.0

appointment			
EventCKD35 — no. (%)	56 (11.4)	36 (14.4)	20 (8.3)

‡ DLD medication was defined as any form of lipid lowering therapy. 85% of all patients with DLD take DLD medication. 83.0% of male patients with DLD take DLD medication and 86.7% of female patients with DLD take medication.

*The variable eGFR Baseline was noted as an inaccurate indicator.

Figure 3. Summary of Calculated Relative Risks, represented by the dots, and 95% Confidence Intervals, represented by the dashes above and below the dots, by sex, showing both comparisons in the entire patient population and for the patient population without a history of smoking. Connecting lines are intended to visually demonstrate sex difference in relative risk.
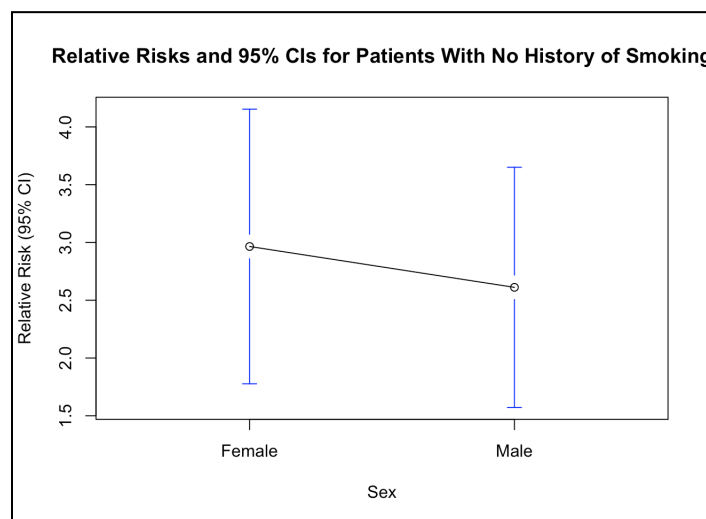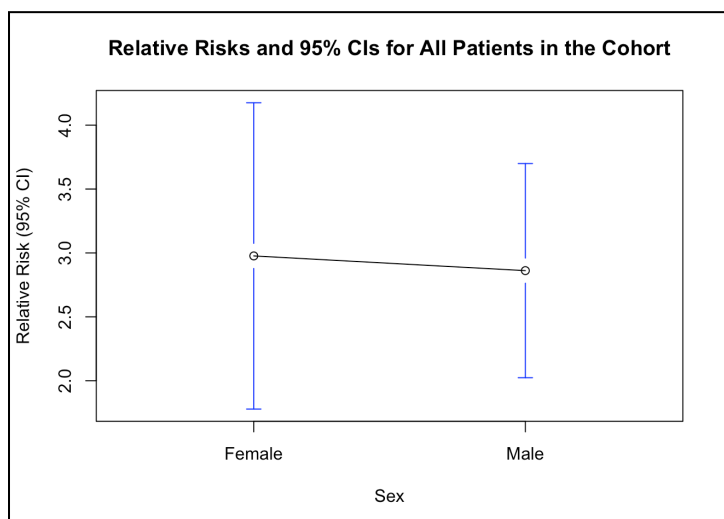
Discussion

In this retrospective cohort study, with data for 491 individuals with CKD in Abu Dhabi, DLD was stronger as a risk factor for CKD in women than men. For the entire population, women were found to only have 4.2% higher RR than men. Upon exclusion of any patient with a history of smoking, it was calculated that women had a 13.4% higher RR than men. This finding may have implications in developing a tailored strategy of care to prevent CKD progression in the patient population. For instance, personalizing treatment regimens for DLD in patients with CKD based on sex could potentially reduce this disparity.

Despite DLD's importance in CKD progression, previous studies related to sex-related disparities address DLD as a risk factor for cardiovascular disease without accounting for it as a large risk factor for CKD due to cardiovascular disease's higher prevalence and urgency. A recent study on 26,378 middle-aged rural Chinese residents concluded that, despite that fact that males were slightly older on average and more likely to have a non-physical job, smoke, consume more alcohol, have hypertension, have heartburn/regurgitation, and eat more unhealthy (spicy and fried) foods, women had a larger prevalence of dyslipidemia and more unbalanced lipids. Women however, did have higher rates of obesity and a history of diabetes [14].

Consistent with this finding, our study found that men followed unhealthier habits than women in every category except for a few: women have a slightly higher BMI and cholesterol, and were 1.5 times or 19.7% more likely to have obesity (Fig. 2). Obesity has been continuously proven to be a large promoter of CKD progression. A high BMI causes increase in intraglomerular pressure, leading to nephron damage that is often permanent. Obesity-related glomerulopathy, a condition marked by damage of the renal glomerulus, has been an exponentially more common condition in recent years [15]. Regardless, this obesity would usually be borderline as the definition of obesity in the United Arab Emirates is a BMI > 30 [16] and women had an average BMI of 31.7 while men had an average BMI of 28.7. Thus, this may not fully explain the disparity of CKD progression.

Another possibility is that women tend to have a higher difficulty relating to DLD medication adherence. The study for the dataset defines DLD medications as any lipid lowering therapies, of which statins are the most commonly used. A review on sex differences of statin adherence observed that in both intentional and unintentional statin adherence, women were less likely to adhere due to decreased healthcare provider awareness surrounding women with DLD, physiology differences, and traditional family responsibilities [17]. It is important to note that this review addresses statin usage for reducing risk of cardiovascular disease and that evidence concerning statin usage to treat DLD and prevent cardiovascular disease in CKD patients is conflicting and inconclusive [6][18]. Interestingly, in our dataset, there is a slightly higher percentage of women taking DLD medication (out of women with DLD) than men taking DLD medication (out of men with DLD).

This study came with numerous strengths. The fact that we analyzed a specific dataset allowed us to have access to the electronic health records of specific patients. Additionally, the

identification of smoking as a confounding variable due to the fact that smoking was much higher in prevalence in men than women allowed us to both further prove smoking as a factor that promotes CKD progression while adjusting our study so that our findings can be applicable to regions where culture around smoking is different.

Although this analysis provided valuable insight into personalized care for DLD pathogenesis in CKD, it had some limitations. Due to the minimal amount of sex-specific and DLD-specific CKD data that is online and accessible, the dataset that we used was small in size, with only 491 patients, and involved data collection in a single hospital over a single year. This may increase the likelihood that our findings don't include CKD patients from countries and cities in different regions with different cultural and racial characteristics. The dataset also didn't include properly collected data on eGFR baseline and, as a result, we had to utilize the Event CKD35 variable to make comparisons between mild CKD and moderate to severe CKD. Using accurately measured eGFR baseline, we could have provided a more valuable and sophisticated insight into differences of DLD related pathogenesis between the sexes. Another limitation in the dataset was that it involved data collected at a single point in time. Studying DLD pathogenesis over multiple points in time may provide further insight on progression, rather than just severity.

Conclusion

This study demonstrated an unequal impact of DLD between women and men on CKD severity, with women having the disadvantage when it comes to severity. This disparity is unlikely to be solely explained by the higher rate of obesity among women and future studies should explore sex differences with statin adherence in CKD. Future studies could explore sex differences of DLD in CKD using meta-analyses and other statistical tools, analyze the data from the most refined measurement of eGFR, and study this phenomenon in other regions, especially more ethnically and racially heterogeneous ones.

Acknowledgements

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Are All Mental Illness Ultimately Physical: A Broad History of an Attempted Definition

By Yao Xiao

Humans have a long history of explaining and battling mental disorders. The second world war brought further attention to these psychiatric illnesses. With veterans suffering from a variety of disorders of character, behavior, and intelligence, the sixth edition of the ICD (International Classification of Disease) was revised to include a section for mental disorders. Additionally, the first edition of DSM (the Diagnostic and Statistical Manual of Mental Disorders) was published in 1952 [American Psychiatric Association]; it's a manual of mental disorders focused on clinical use. However, mental illness is a very difficult topic to define – there are constant debates as to whether it's a physical impairment or psychological dysfunction [Telles-Correia et al] The evidence on both sides is unable to tip the scale in favor of one or the other. Also, the definition of mental disorders is often influenced and determined by broader social factors. For example, homosexuality and other sexual deviations were classified under the sociopathic personality disturbances in its first publication [American Psychiatric Association] This continued in DSM-11, with further clarification that sexual deviations are mental disorders. Gay liberation activists protested directly at APA's discussion conferences, and a panel of discussion on homosexuality was held in 1972, featuring the testimony of a gay psychiatrist – John Fryer [Gordon and Houting] finally, in 1973, APA declared: "We will no longer insist on a label of sickness for individuals who insist that they are well and demonstrated no generalized impairment in social effectiveness," regarding the homosexual community [Lyons] This demonstrated that the definition of mental illness is volatile and easily swayed in different social contexts.

This essay will attempt to define mental disorders by reviewing existing definitions in models and classifications and ultimately coming to the opinion that mental disorders are ultimately physical.

By simply stating "mental illness is ultimately physical", the "ultimate" has two possible meanings: 1. Regardless of the cause, mental disorders will eventually be presented physically for one to see (i.e., symptoms) 2. Mental illnesses are derived from a biological cause. This essay will take both definitions into account. If a model satisfies one or more directions, then it is assumed to be in support of the statement.

DSM's Definition and Criticism

The DSM classifies mental illnesses by their clinically significant behavior; in other words, regardless of the cause, it must be expressed as a "behavioral, psychological, or biological dysfunction in the individual," to quote a study on DSM-IV [Stein et al]. These criteria have the benefit of allowing a concise classification of the disorders. The descriptions of physical symptoms also allow clinicians to diagnose a patient easily. For example, the diagnosis of Major Depressive Disorder consists of 3 criteria: A. the patient must exhibit five or more symptoms for two weeks from a list of nine possible physical indications, such as weight loss and insomnia. B. The disorder has disturbed one's daily life. C. symptoms are not caused by drugs or other illnesses. D. The symptoms cannot be better explained by the criteria for other disorders. E. There has never been a manic or hypomanic-like episode [American Psychiatric Association 125]. All of the listed indications of MDD can be physically observed.

Despite being the principal authority for psychiatric diagnoses in the United States, the DSM did not decide upon the universal diagnostic criteria. Researchers found data on CD and ODD diagnosis in children to be less directed to a universal syndrome and more subject to variation across different cultures [Canino and Alegria]. The same study also expressed that even though DSM-IV acknowledges the importance of practitioners to incorporate contextual and environmental factors in their diagnoses, the DSM "provides no operational or explicit criteria on how to apply this knowledge for clinicians making a diagnosis across cultures." Additionally, China developed its own "Chinese Classification of Mental Disorders" by the Chinese Society of Psychiatry. While sharing some disorders with the ICD and DSM, it included additions such as traveling psychosis, and other deletions, retentions, and variations from the two common western manuals to suit contemporary Chinese society [Lee]. Even though the DSM did not achieve worldwide use, the notion of diagnosis relying on physical symptoms has remained prevalent. Take the example of Major Depressive Disorder again to contrast between the DSM and the CCMD. The diagnosis criteria are practically the same with only minor differences, the patient only needs to satisfy 4 out of 9 physical symptoms to be diagnosed according to the CCMD for example.

Moreover, other critiques received by the DSM involve its labeling nature and its reductionist view of mental disorders. One example is the removal of the "bereavement

exclusion clause" through the revision of DSM-IV to DSM-V. The APA states that the "bereavement exclusion clause" rules out an individual's response to the death of a loved one (e.g., sadness) as symptoms of a major depressive episode, unless those symptoms lasted longer than 2 months after death [NCPDP]. Undoubtedly, it's true that major depressive disorders should not be overlooked, and thus the DSM deleted the clause in its fifth edition [6]. As a result, the threshold of MDD diagnosis became low and labeled grievers to be depressed while merely mourning. Critics claimed that the "DSM-V has made it easier to diagnose MDD among the bereaved, even in the first weeks after their loss," which seemed a bit of a hurried and oversimplified diagnosis. Thus, removing this clause ended up leaving a thin line between melancholia and normal sadness. These debates surrounding the DSM seemed to imply that we can't just base the confirmation of an illness on one's physical symptoms. The stigmatization of mental disorders enhances the error in this simple diagnosis. Studies find that 50% of schizophrenia patients in over 27 countries suffer from discrimination in personal relationships, and 72% felt the need to conceal their diagnosis [Thornicroft et al]. Individuals with mental disorders refuse treatment in fear of losing jobs and livelihood due to stigma, prejudice, and discrimination [Rossler]. Though an important issue to address, proposing a potential solution to solve this social problem is beyond the scope of this essay. However, the broad and labeling diagnosis of the DSM proves to be pushing more people into the stigmatized category of mental disorders. Therefore, solely basing diagnosis on physical symptoms does not produce a sufficiently reliable judgment. This essay will proceed to review a few more models.

The Biomedical View of the Matter

The biomedical model is most commonly accepted for most illnesses and hence is also used extensively by clinicians in creating pharmacological drugs in an attempt to treat mental abnormalities, many of which proved to be effective. Being a more widely applied model than the DSM, it is hoped that the biomedical model would provide more accurate evidence either for or against the idea that mental illness should be considered physical. The biomedical model has a foundation based on molecular biology, and assumes all diseases are attributable to an anatomical and physiological dysfunction [Engel] Mental illness under this framework is defined as a disease of the brain, a change in anatomical structure or/and a chemical imbalance (such that of neurotransmitters) [Deacon] As the former president of the APA Paul Applebaum noted: "Our

brains are biological organs by their very nature. Any mental illness, in essence, a biological process." [Davis] An example is a commonly believed cause of anxiety disorders: the amygdala hyperactivity and the hippocampus hyperactive response to cortisol produced by the HPA axis triggered by an environmental stressor [Bear et al]. Under this framework, mental illness is primarily physical, without difference from somatic disease, and when referring back to the two definitions of "ultimately", fits into definition two.

The biomedical model reduces all diseases to a biological cause, which in turn means that the treatment is targeted at the place of disfunction – for example, removing a tumor. This is effective in somatic diseases but less so with mental disorders, which accounts for the major deficit of this model. Take the monoamine theory for major depressive disorder for example. It hypothesized that the pathophysiological basis for depression is the deficit of monoamine neurotransmitters in the central nervous system. While the clinical observed effectiveness of selective serotonin reuptake inhibitors does support this theory, intensive investigations had failed to identify the source of abnormality in the monoamine system [Delgado]. Although the monoamine theory supports the biomedical model, it itself is still merely a theory and the SSRIs are not always the best treatment for depression. This is true for many mental disorders as they lack the biological markers that mark their cause and presence like somatic illnesses. This weakens the case that all mental illness is physical, since the biomedical model, an advocate for this statement, is unable to demonstrate a biological cause for every mental disorder.

The Biopsychosocial view of the matter

The biomedical model, with no doubt, should be taken into consideration. Medication, however, is not the solution to all mental illnesses. Fundamental causes for mental disorders arise from psychological and social factors, which correspond to the biopsychosocial model – one that acknowledges the contribution of mental and social wellbeing to an illness. With mental, social, and physical factors combined, the biopsychosocial model can explain some "problems of life", to use the analogy of the model's formulator, George Engel. An example of the evolvement of the social environment to mental disorders is how family violence contributes to depression [Guček and Selič]

Cognitive-behavioral therapy branched off this model as a treatment for mental disorders. Comparing the effectiveness of medications (ADMs such as SSRIs) with CBT in depression has

shown that the long-term benefits of CBT exceed that of ADMs. Additionally, studies show that 76% of the ADM responders relapsed into depression after withdrawal, compared to only 31% of patients who had been treated with cognitive behavior therapy [Siddique et al] Though weighing the influence of environmental and psychological factors means the cause of mental illness under this model is not purely physical, patients tend to seek help from a physician when sensing abnormalities in their daily routine of life and either does not know what's wrong or feels incapable of managing it. As mental disorders must be sensed by the patients, they must be, fulfilling the first definition of the keyword "ultimately", physically presented.

Conclusion

A conclusion can be drawn after reviewing three prestigious and influential models/manuals: There aren't any mental illnesses that are not ultimately physical.

Does It Matter

Discussions regarding an illness should ultimately aim at being able to better treat or cure its sufferers. This section aims to discuss the worth of determining if mental disorders are ultimately physical. Going back to the two definitions of "ultimately", both suggest different treatments for mental disorders.

Definition 1 aids individuals in seeking help for their conditions. More educational programmers directed to the identification of symptoms of mental illness would increase patients' receival of treatments.

Definition 2 is useful in inventing drugs and medications to target the cause. For example, in the famously gene-caused disorder schizophrenia, researchers have proposed to use pharmacological inhibition of p110δ – an enzyme coded by the gene PIK3CD and increased by the variation of the ErbB4 gene implicated in schizophrenia. It is shown to block the effects of amphetamine in a rat psychosis model [Law et al], the amphetamine-induced disorder being very similar to that of schizophrenia [Bramness et al]. In this case, the tangible and druggable p110δ is a physical cause that can be used for treatment. In situations where environmental exposures triggered the disorder, such as that of stress-related psychiatric disorders, simply avoiding chronic stress acts as the primary prevention of the illness. The combination of medication and therapy should also be a leading direction of treatment. Nonetheless, discussions regarding

whether mental illness is ultimately physical are worthwhile and beneficial to the future treatment of the disorders.

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Impact of the COVID-19 Pandemic on Organ Donation from Deceased Donors in the United States By Allison Zhu

Abstract

Objective: Death mechanisms of deceased organ donors in the United States provide valuable information about disease trends at the population level . It was unclear how the deceased organ donor pool was impacted by the onset of the Coronavirus disease pandemic in 2020.

Methods: Using the metrics produced by Organ Procurement and Transplantation Network (OPTN) standard analytic files, we analyzed deceased donor death mechanisms between Jan 1st, 2010 to December 31st, 2020 in the US.

Result: Deceased organ donors increased from 11,870 in 2019 to 12,588 in 2020 (6.0% increase) despite the pandemic. Over the 11-year period, deceased donors from drug-intoxication death (drug death donor, or DDD) had the largest percentage increase from 4.3% of all deceased donors in 2010 to 16.1% in 2020, while deceased donors from intracranial hemorrhage/stroke (39.6% to 25.3%), blunt trauma (22.3% to 17.2%) and gunshot wound deaths (10.0% to 7.7%) all experienced decline. Between 2019 and 2020, DDD was the only major death mechanism category that showed significant increase (from 13.5% to 16.1% of all deceased donors in 2019 and 2020, respectively)

Conclusion: During the early COVID-19 pandemic, DDD was the only deceased donor category that showed a major increase. This was likely due to a sharp rise in national drug overdose deaths in the midst of economic and social disruption brought upon by the pandemic.

Introduction

In the United States, all organ procurement organizations and transplant centers report donor data to Organ Procurement and Transplantation Network (OPTN), including age, sex, race, mechanism of death, as well as donor risk type.(Israni et al.) The annual number of deceased donors in the United States increased 29.5% from 2010 to 2017, with deceased donors from drug-intoxication related death (DDD) being the category with highest increase.(Abara et al.) With the unprecedented disruption of healthcare delivery in the United States and the acceleration in drug overdose death during the early phase of the Coronavirus Disease 2019 (COVID-19) pandemic,(Centers for Disease Control and Prevention) it is unknown how

COVID-19 has impacted the organ transplantation operation and the makeup of the deceased donor pool.

Methods

Using the metrics produced by OPTN's Scientific Registry of Transplant Recipients (SRTR) standard analytic files released on March 8th, 2021, we examined characteristics of deceased organ donors between Jan 1st, 2010 to December 31st, 2020. Deceased donor counts included all donors for whom at least one organ was recovered for transplant. Mechanisms of death (asphyxiation, blunt injury, cardiovascular, drug intoxication, gunshot wound, intracranial hemorrhage (ICH)/stroke, natural causes, and seizure) were analyzed. Nationwide age-adjusted annual rates of drug intoxication-related deaths from 2010 to 2020 were obtained from National Vital Statistics System (NVSS).(Hedegaard et al.; *Multiple Cause of Death, 1999-2020 Request*) Descriptive statistics and frequencies were calculated by year to assess trends. Trend analyses were performed using R version 3.3.3 software (R project, Vienna, Austria). Graphics were created by using STATA (*Stata Statistical Software: Release 17*. College Station, TX). This study did not require ethics review board approval because the study subjects were deceased and the dataset used was completely de-identified.

The data reported here have been supplied by United Network for Organ Sharing as the contractor for OPTN. The interpretation and reporting of these data are the responsibility of the authors and in no way should be seen as an official policy of or interpretation by the OPTN or the U.S. Government.

Results

The annual number of deceased organ donors steadily increased from 7,943 in 2010 to 10,286 in 2017, consistent with previous report by Abara et al.(Abara et al.) The increase continued uninterrupted from 2019 (11,870) to 2020 (12,588 ,6.0% increase, Figure 1A). Of the top 5 death mechanism categories: ICH/stroke remained the largest: from 3,143 (39.6% of total deceased donors) in 2010 to 3,181 (25.3%) in 2020, with trend slope for percentage of total deceased donors at -1.4% (p<0.001) (Figure1B). Blunt trauma increased in counts from 1,770 in 2010 to 2,166 in 2020, but decreased in percentage of total from 22.3% to 17.2% (trend slope -0.6%, p<0.001). Gunshot wound similarly saw a small increase in counts from 795 to 963,

while decreased in percentage from 10.0% to 7.7% of all deceased donors from 2010 to 2020 (trend slope -0.2%, p<0.001). Deceased donors from Cardiovascular disease rose from 1,047 (13.2%) to 2,465 (19.6%) during the study period (trend slope 0.6%, p<0.001). DDD led all death mechanism categories with the largest increase in both count (342 to 2,028) and percentage of total (4.3% to 16.1%) from 2010 to 2020 (trend slope 1.3%, p<0.001).
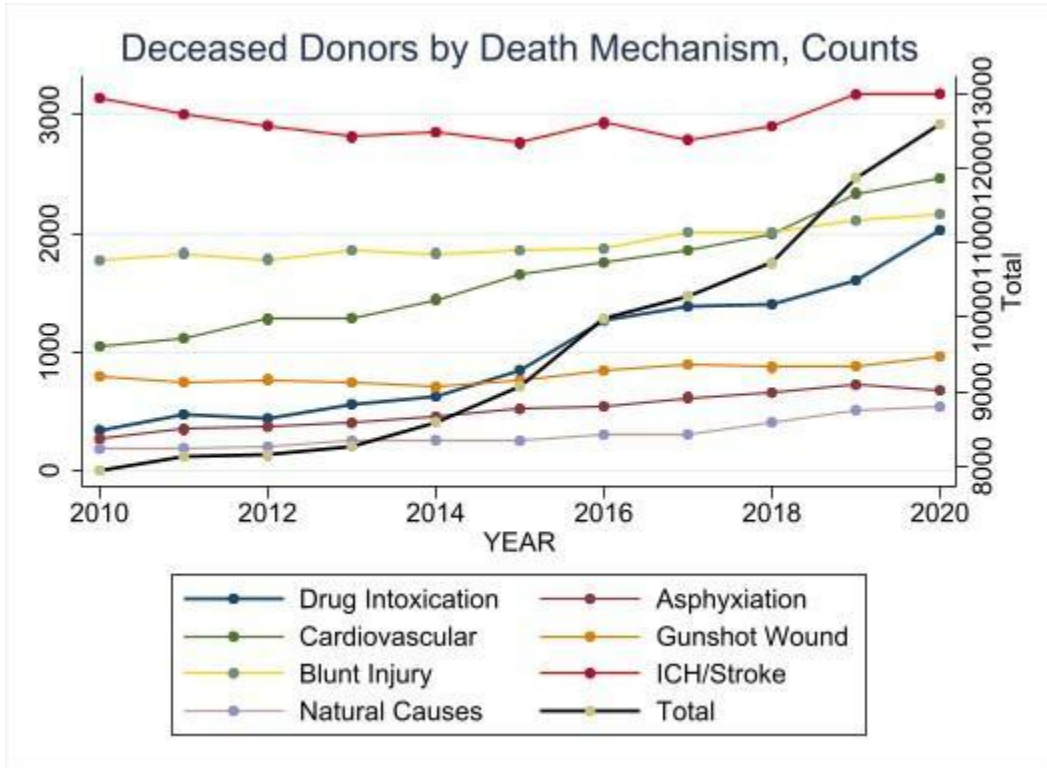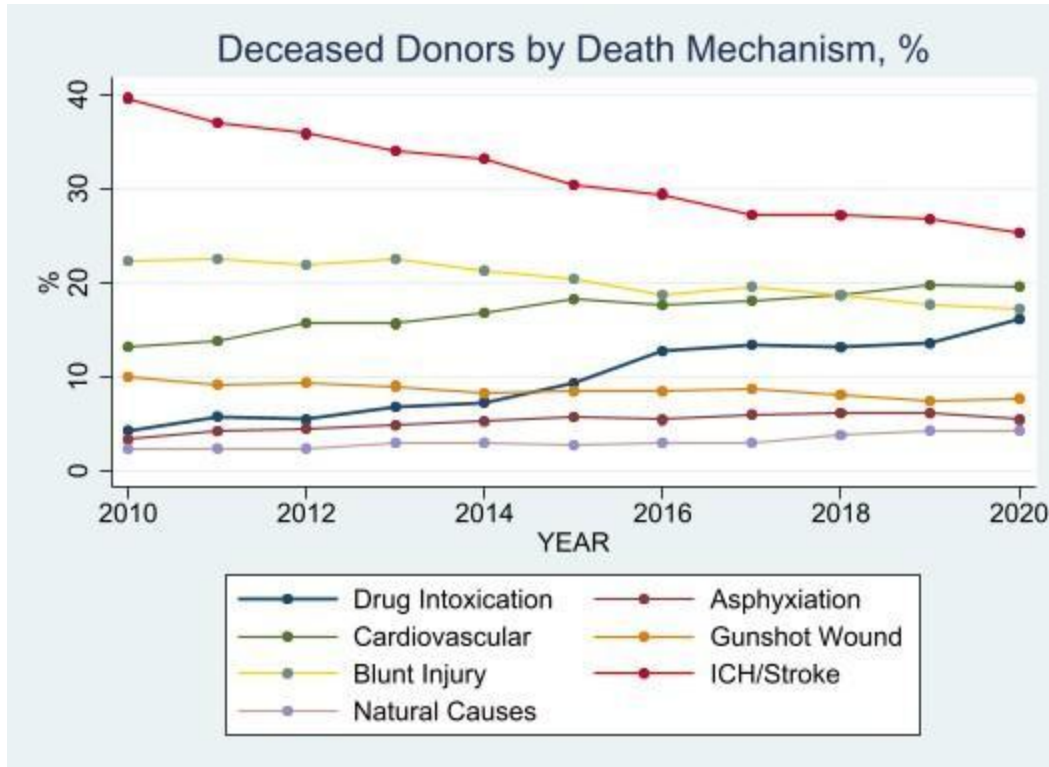

Figure 1A:Death mechanisms of deceased donors, by counts.

Figure 1B: Death mechanisms of deceased donors, by percentages.

Between 2019 and 2020, DDD was the only death mechanism category that showed significant increase: from 1,604 (13.5%) in 2019 (Figure 2A) to 2,028 (16.1%) in 2020 (Figure 2B), $p < 0.001$, while the other categories showed no statistically significant change.
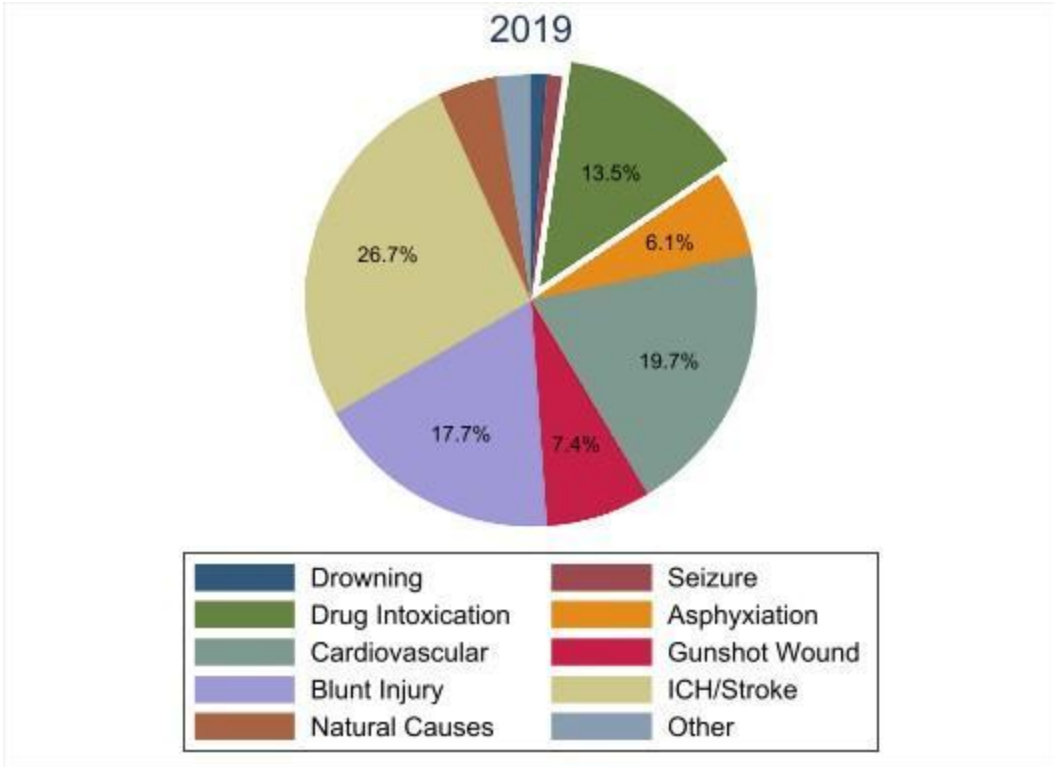
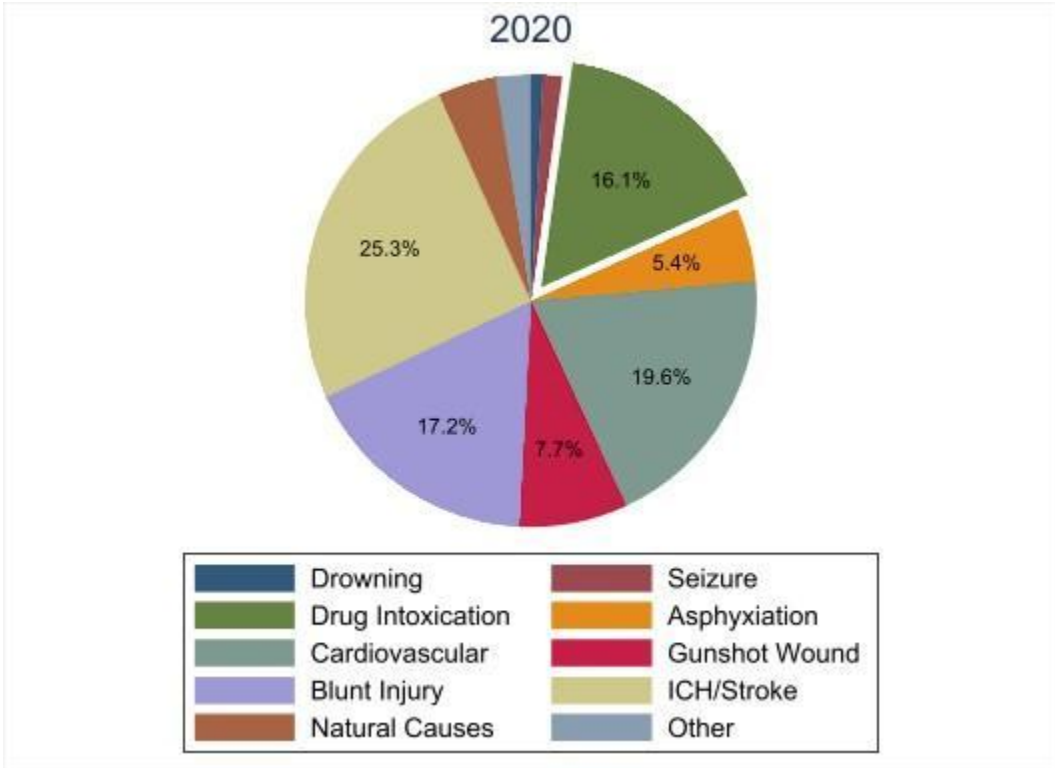**Figure 2A**: Pie chart of deceased donors by death mechanisms in 2019.

Figure 2B: Pie chart of deceased donors by death mechanisms in 2020.

Percentage of DDD of all deceased donors from 2010 to 2020 was plotted against NVSS's age-adjusted national annual drug overdose deaths in Figure 3. The two curves were nearly superimposable starting from 2015. An exponential model predicted the % DDD/national drug intoxication-related death for 2020 at 2.40% and the drug intoxication-related death for 2020 to be 80,936 in the United States, while the final statistics released by NVSS was 91,799.(Hedegaard et al.; *Multiple Cause of Death, 1999-2020 Request*)
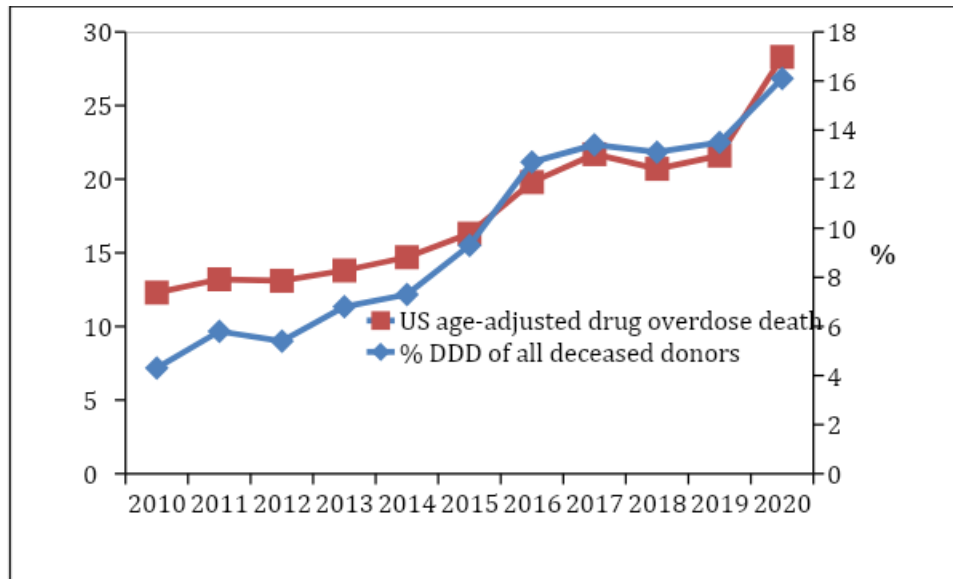

Figure 3: Percentage of DDD of all deceased donors in comparison with US age-adjusted drug overdose death from National Vital Statistics System.

Discussion

Despite the unprecedented impact of the COVID-19 pandemic on the global healthcare delivery, OPTN data showed that deceased organ donors rose appropriately from 2019 to 2020, attesting to the resiliency of the organ donation and transplantation system.
Deceased organ donors remained largely unchanged with an average of 7,486 per year prior to 2010, after which the ongoing U.S. opioid crisis has resulted in an increase in eligible organ donors from drug overdose deaths.("Causes of Death among Deceased Donors") The DDD increase accelerated after 2013 when universal donor testing for Hepatitis B Virus (HBV), Hepatitis C Virus (HCV), and Human Immunodeficiency Virus (HIV) was mandated, and guidelines for categorizing increased risk donors established.(Seem et al.) The passage of *HOPE*

Act allowing organs from HIV infected donors to recipients also with HIV infection (Boxer) as well as the FDA approval of direct acting antivirals to treat HCV in 2015 further boosted the usage of DDD donors. These milestone events led DDD increase by 125% between 2013 and 2016 (from 560 to 1,262, or 6.8% to 12.7% of total deceased donors). This trend, however, slowed and plateaued in 2017 (13.4%), 2018 (13.1%) and 2019 (13.5%), only to see a sharp rise in 2020 (16.1%). Given the close mirroring of DDD of the national drug intoxication death (Figure 3), the most plausible explanation for this significant increase was due to the increased mortality from drug intoxication in the year 2020, when the pandemic related economic hardship, disruption of healthcare, and loss of in-person social support resulted in increased anxiety, depression and social isolation.(Englander et al.) This model projected the national drug overdose deaths at 80,936 for 2020, as compared to 74,511 in 2019. This projection was very close to the reported 81,000 drug overdose death in the one year period ending May 2020 as reported by CDC,(Centers for Disease Control and Prevention) a record breaking number that was believed to be related to COVID-19. While comprehensive prevention strategies are being adapted to address the drug overdose epidemic in the context and aftermath of the COVID-19 pandemic, it remains to be seen how the drug overdose death curve will respond to these interventions, with the DDD data from OPTN (usually available in March of the following year) offering a precious 9 month-lead time for public health efforts to react prior to the NVSS data becoming available towards the end of the year.

The findings in this report are subject to the following limitations: demographic and clinical data were detailed by the annual OPTN/SRTR data report: Deceased Organ Donors(Israni et al.) and hence not included in this brief communication; second, data are limited to donors from whom at least one organ was recovered and do not include persons who might have been considered for donation but from whom no organs were recovered. Therefore, the mechanism of death tally might not fully reflect all persons considered for organ donation.

Conclusion

Analysis of OPTN's deceased donor data showed that number of deceased organ donors with drug intoxication as the mechanism of death rose sharply from 2019 to 2020, reversing a trend of minimal change from 2016 to 2018, likely due to the profound impact of the COVID-19 pandemic on the national drug death crisis.

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