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Erratum

This article was updated March 23, 2021, to correctly reflect the source of the library closure data used in the article's analysis.

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Introduction

As of March 20, 2020, there have been 15,219 reported cases of COVID-19 in the United States of America (Centers for Disease Control and Prevention [CDC], 2020b; Pan American Health Organization [PAHO], 2020). There are 16,568 public library buildings in the United States (American Library Association, 2019). Since they are community centers and publicly owned institutions, libraries are charged with ensuring that their patrons are taken care of and that they are serving their communities to the best of their ability. This role as the community center and a patron-centered place means helping with the public health of the community that funds the library and the greater community at large. The library can help with public health by helping patrons research health issues, offering classes or times to meet with healthcare professionals, or even closing if the times call for it. When the library seems to be a place that people might come into contact with others who are ill, especially when the patrons in question are in at-risk groups, then the greatest service that the library can provide to its community is to close its doors until the crisis has ended. As servants of the community, the last thing that librarians want for their patrons is for them to live through a repeat of the 1918 pandemic of viral influenza that claimed tens of millions of lives (Patterson & Pyle, 1991).

Purpose and Objectives

The purpose of this study is to examine the rate of COVID-19 infections reported to the CDC in the United States and the number of libraries who had self-reported their closures to the American Library Association. This study aims to determine if the infection rates can predict the number of closures and examine the rates of closures within each state to determine if there is a discernable difference between the number of library closures by state.

Research Questions and Hypothesis

RQ1: Can the rate of COVID-19 infections be used to determine the rate of library closures in the United States?

RQ2: What kind of difference is there between the rate of closures of libraries in different states?

A hypothesis related to the first research question can be examined:

H: Libraries are closing at a rate consistent with the cases of COVID-19 reported in the United States.

Literature Review

A review of the literature was conducted to determine the factors affecting the community spread of COVID-19. Public institutions like libraries were given special attention.

COVID-19 and the Novel Coronavirus

The novel coronavirus currently causing the outbreak of COVID-19 is related to the coronaviruses that cause SARS and MERS. Like these other two coronaviruses, this was also most likely zoonotically transmitted to humans (Wu & McGoogan, 2020). Early analyses of the novel coronavirus genetic code showed that it was related to the SARS virus but more closely related to a form of the coronavirus found in bats (Heymann & Shindo, 2020). The disease causes a type of respiratory illness that includes cough, fever, and difficulty breathing, but that remains in the upper part of the respiratory tract (CDC, 2020a; Heymann & Shindo, 2020). Severe cases of the disease may lead to damage to and progressive failure of the respiratory system caused by severe pneumonia with acute respiratory distress syndrome (Xu et al., 2020; Heymann & Shindo, 2020). The elderly and immunocompromised people are at the greatest risk with COVID-19 (CDC, 2020a). Patients of COVID-19

that do not develop severe respiratory distress seem to have their worst symptoms around the tenth day after their initial onset of infection (Pan et al., 2020).

Spread of COVID-19

The novel coronavirus is thought to mostly be spread through respiratory droplets, such as fluids that may leave the body when a sick person coughs (CDC, 2020a). This is a common mode of transmission for respiratory viral infections in humans (Musher, 2003). The reproduction rate of the virus has been examined since it was discovered in December of 2019 by many labs. Initially, the reproduction rate was reported to be lower, at about 1.4 to 2.5, but more recent studies show that the average rate is closer to 3.28 (Liu et al., 2020). The higher rate of reproduction means that the virus can more easily spread than originally thought and could be more contagious than even the SARS coronavirus. It is thought that patients may contract the novel coronavirus if they touch a surface that an infected person has touched or coughed or sneezed on and then touches their face or an open wound. However, there does not seem to be an indication that this is the primary way that the virus is spread (CDC, 2020a).

The Chinese government has made a much more proactive attempt to contain the outbreak of the novel coronavirus than they did with the SARS outbreak in 2003. China has attempted to slow the spread of the virus so that science has a chance to catch up to the virus and find a vaccine (Wu & McGoogan, 2020). The Chinese government's policies to curb the spread of the virus were extreme social distancing policies that they had never implemented before (Mizumoto & Chowell, 2020). The travel bans that governments have imposed, starting with the Chinese government, have a modest effect on the virus's spread. These bans will only have a strong impact on the spread of the virus if the countries implementing them also impose public health interventions on their populations to force them to change their behaviors (Chinazzi et al., 2020).

COVID-19 may have asymptomatic carriers who are unaware that they have contracted the virus (Bai et al., 2020). These individuals may inadvertently pass the novel coronavirus along to other members of their community without realizing what they have done. This issue is compounded by the slow onset of symptoms and the long incubation period in patients that have contracted the virus and will show symptoms but are not yet aware that they are sick (Heymann & Shindo, 2020). There does not seem to be any indication that COVID-19 can be transmitted from a pregnant woman to her baby or cause any issues with pregnancy, the process of giving birth or breastfeeding other than the issues that arise from the general symptoms of the disease (Chen, 2020).

Libraries and Community Spread of Disease

Evidence suggests that relying solely on methods such as vaccines and antiviral drugs for the containment of viral respiratory infections is inadequate (Jefferson et al., 2008). Social distancing is a method that works universally across the globe since any group of people can isolate themselves as much as possible and simply reduce contact with other individuals (Reluga, 2010). In order to help keep people from spreading novel diseases, such as COVID-19, social distancing measures should be put into place since the reduction in contact with other individuals can lead to a decrease in the number of people that are infected overall and to protect public health (Mikolajczyk et al., 2008).

Since libraries are a community meeting place and are community-owned, people tend to gather in them. The groups of people in the community that get the most use out of the library are lower-income Americans, Hispanic Americans, and African Americans (Pew Research Center, 2015). Lower-income Americans are more likely to die of a respiratory illness than higher-income Americans (Wilkinson & Pickett, 2008). African American and Hispanic American people are less likely to receive proper treatment and medications from their physicians than white Americans are (Olesen & Grad, 2018). The use of predictive models to assess the number of people who will fall victim to outbreaks can only go so far. Since these models do not account for factors such as race, ethnicity, or income level, they can neglect these underrepresented groups and underpredict the number of cases, and even deaths, within them

(Colizza et al., 2007). Since these populations have increased vulnerability to these types of diseases, they are at an increased risk at the library during community-spread respiratory disease outbreaks like COVID-19.

Data

Library closure data were obtained through self-reporting of closures, any changes or restrictions they were enacting on programing if staying open, and effective dates for the changes. These data were compiled into a spreadsheet by Michael Sauers, Julie Erickson, and Heather Braum (2020)[1]. The data were then cleaned and analyzed by hand to be processed using Microsoft Excel and IBM SPSS. The data included in the spreadsheet created by Sauers et al. (2020) included closure dates in natural language from the individual libraries' reports or announcements about their closings. The dates of closing were extracted from these data. The states in which each library resides were also extracted and coded. These data were retrieved on March 17, so the closing dates were reported up until March 16.

The data for the incidence of COVID-19 cases in the United States were retrieved from the CDC (2020b). These data only include the cases that have been reported to the CDC and cannot count cases that health departments across the United States have chosen not to report. The data include the date on which the case was reported to the CDC and the number of reported cases each day but does not consider cases repatriated to the United States from Wuhan, China, or Japan. Since the data for the closures were only for March 1 through March 16, the same dates were taken for the reported cases of COVID-19.

From the dates and cases taken from the samples in the retrieved data, relationships were assessed. The relationship between the number of cases of COVID-19 reported to the CDC (CV), and the number of libraries (NL) that were closed was initially assessed. The linearity was evaluated with a normal P-P plot and by assessing the skewness and kurtosis of the data (see Table 1). Linearity was met for the data. Homoscedasticity was evaluated using standardized residual and standardized predicted value scatterplots.

A regression analysis was conducted with the number of cases of COVID-19 reported to the CDC by day and the number of libraries that were closed in response. The overall result of the analysis was found to be statistically significant ($F(1,14) = 20.64$, $p < .001$), indicating that the number of cases that were being reported by day could be used to predict the number of libraries that would close. The rate of the closures could be determined at: NL = -91.40 + .193(CV). This indicates the null hypothesis should be rejected.

The states in which the reporting libraries resided were also analyzed for the number of closures in each state ($N = 2794$) and on which dates these closures occurred ($N = 17$). The states and the District of Columbia were each given a code, and then these codes were examined for their rate of closure. This analysis included libraries that had been closed but had not reported their date of closing. Michigan ($n = 776$), New Hampshire ($n = 318$), and Texas ($n = 237$) had the highest rate of library closures, while Alaska, North Dakota, and Wyoming all had the lowest number of closures ($n = 1$). The earliest closures began on March 2 ($n = 14$), and the greatest number of closures happened on March 16 ($n = 1297$). Some of the libraries chose not to report their dates of closure ($n = 852$), and there were no closures on March 1, March 3, March 4, March 5, March 8, or March 10. See Table 2 for more information.

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[1] Correction to remove ALA as repository / March 16, 2021

Table 1. Descriptive Statistics for Analysis of COVID-19 and Library Closure Rates

	Range	M	SD	Skewness	Kurtosis
Cases of COVID-19	4196	1100.75	1290.81	1.39	1.20
Closed Libraries	1297	121.38	323.24	3.62	13.75

Note: The data for this table were taken from March 1, 2020, until March 16, 2020.

Table 2. Library Closures by State and Day

	No Date	2	6	7	9	11	12	13	14	15	16	Total
AK											1	1
AL	4									1	2	7
AR	4										2	6
AZ	5						1	1			12	19
CA	8			1			1	3	11	2	1	27
CO	100							2	7	3	6	118
CT	15					4	12	58	16	3	40	148
DC	1						1				1	3
DE									1		1	2
FL	3		1					2		3	8	17
GA	3							1		3	5	12
HI												0
IA	4									3	4	11
ID	1								1		2	4
IL	23						1	6	7	2	19	58
IN	6						1	1	2	1	6	17
KS	13			1				1	3	1	5	24
KY	4							2		3	2	11
LA	2										1	3
MA	13						3	9	9	1	13	48
MD	1							2	3	1	5	12
ME	3								1		3	7
MI	33						1	16	24	11	691	776
MN	2							1			3	6
MO	36		1							1	7	45
MS									1		1	2
MT	1		1							1		3
NC	3							1		1	2	7
ND	1											1
NE	13							2	2	1	7	25
NH												0
NJ	170						10	31	32	15	60	318
NM												0
NV	16										2	18
NY	13		1					3	12	2	21	52
OH	23		1					32	25	26	87	194

OK	4					1	1		6
OR	16	1		1	4	16	8	14	60
PA	3				6	6	2	5	22
RI	7				2	5	4	26	44
SC	4			1		1		4	10
SD					1		1	1	3
TN	4					2		1	7
TX	196	1			6	6		28	237
UT	2				2		3		7
VA	1				2	3		4	10
VT	3		1		4	3	10	41	62
WA	2			2	10	17	5	21	57
WI	84	3			3	8	22	99	219
WV	2	4		1	2	2	4	32	47
WY								1	1

Note: The data for this table was taken from March 1, 2020, until March 16, 2020.

Discussion

Based on the regression analysis of the library closures, it can be inferred that the libraries that reported themselves as closed did so as the cases of COVID-19 increased at a predicable rate. It seems that the libraries were taking the initiative to close themselves, except in the cases where the state governors ordered the closures of all libraries within the state (Sauers et al., 2020). The numbers of library closures within each state indicate that library directors in different states viewed their roles in the outbreak differently. Since some of the groups that get the most use out of the library are also the groups that have some of the greatest risks of death from COVID-19, it falls on the library to take responsible action (Pew Research Center, 2015; Wilkinson & Pickett, 2008; Olesen & Grad, 2018).

Libraries should take a note from schools. When schools are closed, children are less than half as likely to come in contact with another person, reducing their chances of contracting a respiratory illness (Mikolajczyk et al., 2008). In states such as Michigan and New Hampshire, where more libraries closed, the systems viewed the libraries as meeting places. They saw that closing the libraries could be beneficial to the public health of these locations. However, the states such as Alaska, North Dakota, and Wyoming that only closed the one library may view their libraries as essential services for their users, or they do not understand the ways that libraries can contribute to the spread of disease as a

meeting place without social distancing measures in place (Mikolajczyk et al., 2008). Libraries may have begun to close earlier in order to stave off the spread of COVID-19 within their communities, but there are essential services that their patrons require, and there is no guarantee that this could have helped without other institutions or businesses closing as well.

The limitations of this study include the limited range of dates for which the data were available for the analysis. The data were also self-reported. Since the data were self-reported and voluntary, libraries did not have to report if they were open or closed. Not all the libraries that were closed during the dates of the study may have been included. The data from the CDC may have also been limited by underreporting. There may have been local health departments that had not yet reported cases for the dates included in the study. Further study should be conducted to determine the closures for a larger range of dates. Studies could also be conducted to determine the relationships between COVID-19 cases and library closures with more granularity.

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