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Is Social Media to Blame for the Sharp Rise in STDs?

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Abstract: Rhode Island, New Zealand, and southern California recently reported sharp increases in sexually transmitted diseases (STDs). Health department officials stated that these increases appeared to be due to the more widespread use of social media like Tinder, Grindr, and Facebook, which allow users to readily connect with and meet others. The purpose of this study was to see if U.S. states that have more users of social networking sites, dating sites, and dating apps like Match.com, Ashley Madison, Our Time, Down Dating, Bumble, Zoosk, Hinge, Score, At First Sight, Plenty of Fish, Eharmony, Adult Friend Finder, Tinder, Grindr, and Facebook have more cases of STDs after controlling for population, race, age, income, education, and population density. It was found that states with more users of Match.com, OKCupid, and Down Dating had a larger number of cases of STDs, while states with more users of Our Time, Ashley Madison, Facebook, How About We, Hinge, Adult Friend Finder, Grindr, Bumble, Score, Tinder, and At First Sight had fewer cases of STDs. While social networking sites make it easier for individuals to be exposed to an STD since in-network individuals may share an STD, many sites either attract individuals who are not interested in a short-term sexual relationship or who take precautions to avoid contracting an STD.

Keywords: STDs; social media; Match.com; OKCupid; Down Dating; social networking

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1. Introduction

According to the Centers for Disease Control and Prevention (CDC), there were more cases of sexually transmitted diseases (STDs) in the United States in 2015 than ever before (Howard 2016). The three most commonly reported STDs are syphilis, gonorrhea, and Chlamydia. Rhode Island recently experienced a surge in sexually transmitted diseases (STDs) with syphilis, gonorrhea, and HIV increasing by 79%, 30%, and 33%, respectively, from 2013 to 2014 (Whitman 2015). The Department of Health attributed these increases in part, to the increased use of social media and the casual encounters they engendered. Whitman (2015) also stated that outbreaks of syphilis in New Zealand in 2012 and syphilis and gonorrhea in the United Kingdom were thought to be related to the app 'Grindr' and other similar apps. According to the Daily Mail Reporter (2011), Peter Greenhouse of the British Association for Sexual Health and HIV stated that an STD could be contracted in minutes with the availability of apps such as Tinder or Grindr. By simply swiping on these apps to accept the conversation of another, two people could quickly get together for a casual affair. Others, however, believe that social media is not to blame for the rise in STDs, but rather it is lack of education and access to condoms (Mohney 2015).

Nazarian (2014) reported on the rise in STDs in southern California that was being associated with the use of social media. The California Department of Health statistics showed a 13% increase in gonorrhea rates and an 18% increase in syphilis rates from 2012 to 2013.

There are health officials who believe that social networking sites like Facebook make it easier for individuals to meet, get to know each other, and have casual sex leading to STDs, while others believe that social media is not responsible for the increase in STDs (Berr 2010). These studies have introduced

the idea of social networking sites having an impact on STDs, but there is still a significant gap in the literature. The purpose of this paper is to identify the leading social networking sites, including online dating sites and dating apps such as Tinder, Zoosk, Bumble, Hinge, and many others, that have become popular in recent years and to see if they are associated with STDs in different U.S. states. The results will be useful to state health officials who are trying to inform and educate the public about the causes, consequences, and means of avoiding STDs.

2. Social Media

Alloway et al. (2014) stated that social networking sites could lead to more or less empathy in individuals using those sites. Social networking allows individuals to be exposed to others who they would not otherwise meet. Thus the opportunity for empathy towards others is expanded. On the other hand, individuals using social networking sites may become less and less sensitive to the problems and concerns of others, leading to less empathy and more narcissism. The link between social media usage and narcissism has been discussed by several authors (Agrawal 2016; Firestone 2012; Nauert 2016). Alloway et al. (2014) found that posting updates on Facebook was associated with narcissism and exaggerated feelings of self importance for females. Widman and McNulty (2011) stated that narcissism and infidelity associated with narcissism could lead to a greater risk of contracting an STD.

The first step in building a model of the relationship between social media and STDs is to identify the extent to which individuals are using social media to meet and date other people. The Pew Research Center (2013) conducted a national survey on online dating and relationships. They found the following:

- 11% of internet users say that they have personally used an online dating site such as Match.com, eHarmony, or OKCupid (p. 2).
- 66% of these online daters have gone on a date with someone they met through a dating site or app, and 23% have met a spouse or long term partner through these sites (p. 1).
- Some 79% of online daters agree that online dating is a good way to meet people, and 70% of them agree that it helps people find a better romantic match because they have access to a wide range of potential partners (p. 3).
- Today six out of every ten Americans use social networking sites (SNS) such as Facebook or Twitter, and these sites are often intertwined with the way they experience their past and present romantic relationships (p. 6).
- Additionally, one-third of internet users (33%) agree with the statement that 'online dating keeps people from settling down because they always have options for people to date' (p. 21).
- Among those who use cell phone apps, 7% say that they have specifically used a dating app on their phone.
- Moving beyond dates, one quarter of online daters (23%) say that they themselves have entered into a marriage or long-term relationship with someone they met through a dating site or app (p. 23).

The above statistics show that people are now using social networking sites, dating sites, and dating apps to expand their opportunities and chances of meeting someone. Furthermore, dating sites and apps are constantly being developed to target a specific market. Some cater to more mature individuals, some to professionals, some to the more religious, and some to higher income groups. Some dating sites require their clients to fill out comprehensive surveys and questionnaires to ensure the best possible matches. Others like 'Tinder' enable users to quickly download the app and immediately contact those who they find attractive.

3. Data and Methodology

There is no agreement as to which dating sites and apps are the top ones, but some of the more popular ones included in this study are: (1) Match.com; (2) Our Time; (3) Hinge; (4) Hitch; (5) How

About We; (6) OKCupid; (7) Grindr; (8) Down Dating; (9) Bumble; (10) Score; (11) At First Sight; (12) Plenty of Fish; (13) Eharmony; (14) Zoosk; (15) Tinder; (16) Adult friend finder; (17) Ashley Madison; (18) Instagram; and (19) Facebook. Many social networking sites like Facebook have been known to allow people who once knew each other to reconnect and rekindle old friendships, and these are thus included with the other dating apps and dating sites listed above.

The exact number of users by state for each of the above dating sites, apps, and social networking sites is unknown and generally unreported. Traditional research methods would suggest survey data be used to obtain user data, but that is costly and requires the targeting of respondents. Recent literature has turned to search engine methods data for gathering unreported items such as food safety in China, which was studied by Chen et al. (2015). Google Trends does report a 'search volume index' by state and by year for the number of searches for a particular term like 'Zoosk.' The search volume index ranges from 0 to 100, so a state with an index of 75 would have a number of Google searches for Zoosk as a percent of total Google searches equal to 75% of the number of searches from a state with an index of 100, relative to that state's total Google searches. For example, suppose that, for the state of Oregon, 12 percent of its total Google searches in 2013 were for the search term 'Zoosk'. Also suppose that the state of Arizona had the highest percent of total Google searches in 2013 for 'Zoosk' at 16%. All state percentages are then normalized to Arizona's percentage. This is accomplished by dividing each state's percentage by 16 percent and multiplying by 100. Thus the resulting 'search volume index' for Arizona for 'Zoosk' in 2013 would be 100. For Oregon, it would be 75. According to Rudder (2014), Google Trends search indexes have been used by many professionals and scientists to track items such as stock prices, economic activity, and the spread of disease. Once a disease starts to spread, people engage in Google searches for symptoms and cures. The number of Google searches can then be tracked over time to monitor the progress of the disease.

The search volume indices for the above 19 dating sites, apps, and social networking sites were used in this study to measure the number of Google searches coming out of a state relative to another state that has an index of 100. A larger number of searches for, say, 'Eharmony' from a state (as a percent of total Google searches) was used to represent a larger number of users of this dating site (as a percent of the state's population) since dating sites and apps do not normally provide information on the actual number of users by state and by year.

To see if a greater number of users (searches) of the above dating sites and apps in different states is associated with a larger number of STDs, STDs by state were collected from the Centers for Disease Control and Prevention (2013a). The Centers for Disease Control and Prevention (2013b) found that Chlamydia rates varied for different races and ethnic groups. In 2013, the Chlamydia rate was 377 cases per 100,000 population for Hispanics, 111.5 cases per 100,000 population for Asians, and 1147.2 cases per 100,000 population for blacks. The Chlamydia rate for whites was below that of blacks and Hispanics but was 1.6 times that for Asians. The Gonorrhea rate was 426.6 cases per 100,000 population for blacks, 34.5 cases per 100,000 population for whites, 65.8 cases per 100,000 population for Hispanics, and 17.1 cases per 100,000 population for Asians. The Syphilis rate was 16.8 cases per 100,000 population for blacks, 6.3 cases per 100,000 population for Hispanics, three cases per 100,000 population for whites, and 2.5 cases per 100,000 population for Asians (p. 1). The number of STD cases also varied by gender and age groups.

Harling et al. (2013) found evidence that income levels and STDs were negatively correlated, with higher income groups having a smaller rate of STDs. This finding was consistent for all racial and ethnic groups.

Given the above findings by the CDC and other researchers, the following model was estimated to analyze the effects of social media on STDs for males and females.

$$STDs_{jki} = \beta_1 + \beta_2(Population_i) + \beta_3(African.Am_i) + \beta_4(Hispanic_i) + \beta_5(Age_i) + \\ \beta_6(Income_i) + \beta_7(Education_i) + \beta_8(Pop.Density_i) + \beta_9(Social.Media_i) + \varepsilon_i \tag{1}$$

For the dependent variable, $STDs_{jki}$, the subscript j refers to the type of STD for which data was collected, where $j = 1$ for the number of cases of Chlamydia, $j = 2$ for the number of cases of Syphilis, and $j = 3$ for the number of cases of Gonorrhea. The subscript k refers to the gender of those who had an STD, where $k = 1$ for females and $k = 2$ for males. The subscript 'i' refers to the U.S. state in which the number of STD cases was collected for the given year 2013. Thus the first STD equation that was estimated was for $STDs_{11i}$, which represented the number of cases of Chlamydia for females for the different states (plus the District of Columbia). The second STD equation that was estimated was for $STDs_{12i}$, which represented the number of cases of Chlamydia for males for the different states. The third STD equation that was estimated was for $STDs_{21i}$, which represented the number of cases of Syphilis for females for the different states. Three other equations were estimated for Syphilis for males, Gonorrhea for females, and Gonorrhea for males. Thus, six STD equations were estimated for a given social networking site; three for females and three for males. Furthermore, nineteen different social networking sites were entered into the six equations individually. In total, 114 equations were estimated (6×19).

In Equation (1), *Population* is the size of the state's population, *African.Am* is the number of African Americans in a state as a percent of the state's population, *Hispanic* is the number of Hispanics as a percent of the state's population, *Age* is the number of individuals 65 years of age and older as a percent of the state's population, *Income* is per capita money income in the state, *Education* is the number of high school graduates or college graduates who are 25 years of age or older as a percent of the state's population, *Pop.Density* is the number of persons per square mile in a state, and *Social.Media* is the Google Trends search volume index for a particular form of social media (like Tinder, Facebook, etc.). If the coefficient of the social media variable is positive and significant, there is evidence that social media may be partly responsible for the increase in STDs after controlling for population, race, age, income, education, and population density.

The independent variables in Equation (1) that were expected to be positively related to number of state STD cases were *Population*, *African.Am*, *Hispanic*, and *Pop.Density*. The CDC statistics show that the number of STDs per 100,000 population are higher for the African American and Hispanic communities. It was also expected that states with more people and more people living closely together would have a greater number of cases of STDs.

The independent variables in Equation (1) that were anticipated to be inversely related to number of state STDs included *Age*, *Income*, and *Education*. CDC statistics show that the number of STD cases falls off significantly for those over 65 years of age, and, as previously stated, Harling et al. (2013) showed that higher income individuals had lower rates of STDs. Since education and income are positively correlated, it was also expected that groups with higher levels of education would have lower rates of STDs, holding everything else constant.

All of the variables used in this study and their descriptive statistics are presented in Table 1. All of the variables other than number of cases of STDs and Google Trends search volume indices representing different forms of social media were taken from the U.S. Census Bureau's website. Furthermore, most variables used in this study were 2013 figures, unless otherwise noted in Table 1 (U.S. Census Bureau n.d.).

Table 1. Variables and Their Descriptive Statistics.

Variable	Description	Mean	Standard Deviation
Chlamydia.Males	number of cases of Chlamydia (males—by state: 2013)	7953.96	9694.35
Chlamydia.Females	number of cases of Chlamydia (females—by state: 2013)	19,477.4	22,537.3
Gonorrhea.Males	number of cases of Gonorrhea (males—by state: 2013)	3316.28	4432.74
Gonorrhea.Females	number of cases of Gonorrhea (females—by state: 2013)	3200.16	3709.06
Syphilis.Males	number of cases of Syphilis (males—by state: 2013)	317.2	548.5
Syphilis.Females	number of cases of Syphilis (females—by state: 2013)	37.28	47.04
Population	state population: 2013	6,205,834	7,051,231
African.Am	African Americans as a percent of state's population: 2013	11.60	10.92
Hispanic	Hispanics as a percent of state's population: 2013	11.19	10.04
Age	percent of state's population over 65 old: 2013	14.38	1.75
Income	per-capita money income over 12 months: 2009–2013, by state	28,053.8	4659.38
Education	percent of population 25 years old and over who were high school graduates or higher by state: 2009–2013	85.98	11.34
Pop.Density	persons per square mile by state: 2010	384.40	1377.36
Match.com	search volume index by state: 2013	71.82	12.44
Ourtime	search volume index by state: 2013	36.06	36.63
Hinge	search volume index by state: 2013	62.35	29.05
Hitch	search volume index by state: 2013	51.25	15.93
How About We	search volume index by state: 2013	38.16	29.68
OkCupid	search volume index by state: 2013	53.39	20.44
Grindr	search volume index by state: 2013	41.08	32.09
Down Dating	search volume index by state: 2013	83.84	5.97
Bumble	search volume index by state: 2013	56.06	24.78
Score	search volume index by state: 2013	78.14	9.91
At First Sight	search volume index by state: 2013	10.31	18.76
Plenty of Fish	search volume index by state: 2013	78.02	11.79
Eharmony	search volume index by state: 2013	63.90	18.64
Zoosk	search volume index by state: 2013	51.57	16.56
Tinder	search volume index by state: 2013	39.41	26.93
Adult Friend Finder	search volume index by state: 2013	42.45	26.35
Ashley Madison	search volume index by state: 2013	21.73	36.02
Instagram	search volume index by state: 2013	61.67	17.23
Facebook	search volume index by state: 2013	67.02	13.18

4. Results

In estimating the STD equations to determine the effects of social media on STDs, each of the dating sites and apps were entered into the equation one at time, as previously stated. The reason for this approach is that many individuals use multiple dating apps. If several or all of the dating apps were entered into the equation at the same time, many of them would be correlated, leading to the problem of multicollinearity and inflated standard errors of the estimated coefficients of the independent variables. The results are presented in Tables 2–4, and 51 observations (50 states and the District of Columbia) were used to estimate the models for Chlamydia and Gonorrhea. Due to missing values for some variables, 50 observations were used to estimate the syphilis model for males and 40 observations were used to estimate the syphilis model for females. Only the results containing a significant effect of a social media site were reported in all the tables.

In Table 2, the Chlamydia model estimates are presented. The variance inflation factors (VIFs) associated with each of the independent variables were below five, indicating that multicollinearity was not a problem. In a multiple regression model, the variance of the estimated coefficient of the jth independent variable is inflated or increased by a variance inflation factor, which is given by the equation, $1/(1 - R_j^2)$, where R_j^2 is the R-squared statistic obtained from regressing the jth independent variable on all other independent variables. If R_j^2 is 0.8, for example, then 80 percent of the variation in the jth independent variable is explained by the other independent variables, which would indicate a high degree of multicollinearity among the independent variables. In this case, the variance inflation factor (VIF) for the jth independent variable would be 1 / (1 − 0.8) = 5. It is typically assumed that if an independent variable has a VIF of five or greater, multicollinearity is a problem that increases the estimated standard errors of the estimated coefficients and results in low t-statistics.

White's general heteroscedasticity test also indicated no presence of heteroscedastic errors. Models 1 to 5 for Chlamydia were for males and Models 6 and 7 were for females.

Table 2. Regression Results for Chlamydia.

Dependent Variables	Chlamydia Males (1)	Chlamydia Males (2)	Chlamydia Males (3)	Chlamydia Males (4)	Chlamydia Males (5)	Chlamydia Females (6)	Chlamydia Females (7)
Independent Variables							
Intercept	1495.74 (0.478) †	409.77 (0.132)	6761.2 * (1.953)	1087.0 (0.366)	5889.6 * (1.816)	10696 ‡ (1.660)	15593.3 ** (2.456)
Population	0.001 *** (35.39)	0.001 *** (36.489)	0.001 *** (35.881)	0.001 *** (31.399)	0.001 *** (33.348)	0.003 *** (38.580)	0.003 *** (39.496)
African.Am	42.46 (1.581)	42.19 * (1.69)	26.65 (1.107)	33.36 (1.399)	41.21 ‡ (1.648)	237.20 *** (4.287)	227.4 *** (4.128)
Hispanic	−6.97 (−0.265)	−3.004 (−0.117)	−18.64 (−0.725)	−21.10 (−0.834)	−4.54 (−0.177)	74.84 (1.38)	85.43 (1.522)
Age	−167.2 (−1.26)	−60.23 (−0.486)	−195.9 (−1.499)	−81.25 (−0.669)	−39.31 (−0.312)	−626.36 ** (−2.291)	−432.54 ‡ (−1.640)
Income	−0.096 (−1.41)	0.013 (0.210)	−0.13 * (−1.844)	0.007 (0.114)	−0.092 (−1.489)	−0.454 *** (−3.250)	−0.384 *** (−2.97)
Education	−3.73 (−0.197)	−4.94 (−0.274)	−30.25 (−1.193)	−9.026 (−0.509)	−6.62 (−0.366)	4.46 (0.114)	−1.34 (−0.034)
Pop.Density	0.17 (0.71)	−0.08 (−0.330)	0.107 (0.464)	0.012 (0.050)	0.068 (0.298)	−0.096 (−0.196)	−0.264 (−0.538)
Match.com	39.13 ‡ (1.609)					102.21 ** (2.04)	
OurTime		−16.39 ** (−2.33)					
OkCupid			33.35 ** (2.179)				
Ashley Madison				−20.37 ** (−2.551)			
Facebook					−51.43 ** (−2.25)		
Adult Friend Finder							−34.44 * (−1.762)
R-squared	0.981	0.982	0.982	0.982	0.982	0.985	0.985
Adj. R-squared	0.977	0.978	0.978	0.979	0.978	0.982	0.982
AIC statistic	17.57	17.51	17.53	17.49	17.52	19.02	19.04

† t-statistics appear in parentheses; ‡ significant at the 12% level; * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level; n = 51.

Table 3. Regression Results for Gonorrhea.

Independent Variables	Dependent Variables: Gonorrhea Males (1)	Gonorrhea Males (2)	Gonorrhea Males (3)	Gonorrhea Males (4)	Gonorrhea Males (5)	Gonorrhea Males (6)	Gonorrhea Males (7)	Gonorrhea Males (8)	Gonorrhea Males (9)	Gonorrhea Males (10)	Gonorrhea Males (11)
Intercept	1884.74 ‡ (1.642) †	1630.9 (1.375)	2638.2 ** (2.262)	2835.8 ** (2.508)	2773.3 ** (2.456)	−719.2 (−0.296)	2628.8 ** (2.200) †	4551.9 *** (3.076)	3360.2 ** (2.947)	2164.2 * (1.830)	4237.4 *** (3.284)
Population	0.001 *** (43.88)	0.001 *** (43.130)	0.001 *** (43.055)	0.001 *** (41.078)	0.001 *** (41.120)	0.001 *** (41.324)	0.001 *** (41.99)	0.001 *** (40.235)	0.001 *** (44.221)	0.001 *** (35.450)	0.001 *** (37.682)
African.Am	43.94 *** (4.459)	39.60 *** (4.148)	33.51 *** (3.510)	40.32 *** (4.135)	39.58 *** (4.103)	31.35 *** (3.174)	35.68 *** (3.575)	34.91 *** (3.475)	41.62 *** (4.208)	34.11 *** (3.596)	37.56 *** (3.774)
Hispanic	5.71 (0.591)	6.57 (0.67)	5.94 (0.584)	1.23 (0.125)	3.32 (0.339)	9.45 (0.831)	5.28 (0.508)	−5.05 (−0.460)	9.24 (0.917)	−2.10 (−0.208)	5.03 (0.493)
Age	−112.81 ** (−2.317)	−40.33 (−0.852)	−53.59 (−1.10)	−84.93 * (−1.774)	−83.18 * (−1.744)	−51.13 (−1.002)	−44.80 (−0.888)	−66.41 (−1.321)	−54.98 (−1.161)	−53.59 (−1.109)	−35.26 (−0.702)
Income	−0.121 *** (−4.843)	−0.050 ** (−2.113)	−0.08 *** (−3.409)	−0.07 *** (−3.039)	−0.067 *** (−3.001)	−0.072 *** (−3.013)	−0.078 *** (−3.386)	−0.079 *** (−3.377)	−0.10 *** (−4.347)	−0.06 ** (−2.448)	−0.10 *** (−4.101)
Education	−3.38 (−0.487)	−5.62 (−0.813)	−2.84 (−0.381)	−5.35 (−0.765)	−5.32 (−0.763)	−1.73 (−0.207)	−4.57 (−0.610)	−10.61 (−1.426)	−4.92 (−0.701)	−7.90 (−1.120)	−6.85 (−0.952)
Pop.Density	0.20 ** (2.33)	0.06 (0.622)	0.175 * (1.933)	0.142 ‡ (1.621)	0.176 * (1.999)	0.17 * (1.822)	0.16 * (1.724)	0.15 ‡ (1.592)	0.15 * (1.736)	0.12 (1.284)	0.14 (1.543)
Match.com	30.28 *** (3.394)										
OurTime		−8.68 *** (−3.23)									
Hinge			−7.73 ** (−2.587)								
How About We				−10.63 *** (−3.068)							
Grindr					−10.33 *** (−3.10)						
Down Dating						30.86 * (1.718)					
Bumble							−7.78 ** (−2133)				
Score								−18.15 * (−2.33)			
Adult Friend Finder									−10.78 *** (−3.071)		
Ashley Madison										−8.72 *** (−2.745)	
Facebook											−22.31 ** (−2.453)
R-squared	0.988	0.987	0.986	0.987	0.987	0.985	0.986	0.986	0.987	0.987	0.986
Adj. R-squared	0.985	0.985	0.984	0.985	0.985	0.983	0.983	0.983	0.975	0.984	0.984
AIC statistic	15.57	15.59	15.66	15.61	15.60	15.74	15.71	15.73	15.61	15.65	15.68

† t-statistics appear in parentheses; ‡ significant at the 12% level; * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level; n = 51.

Table 4. Regression Results for Syphilis.

Independent Variables	Dependent Variables: Syphilis Males (1)	Syphilis Males (2)	Syphilis Males (3)	Syphilis Males (4)	Syphilis Males (5)	Syphilis Males (6)	Syphilis Females (7)	Syphilis Males (8)	Syphilis Males (9)	Syphilis Females (10)	Syphilis Females (11)	Syphilis Females (12)
Intercept	−431.82 (−0.319) †	459.33 (0.331)	466.5 (0.353)	534.12 (0.389)	571.9 (0.415)	1192.4 (0.859)	60.56 (0.328)	−156.25 (−0.116)	723.02 (0.536)	98.04 (0.538)	26.58 (0.144)	−26.79 (−0.142)
Population	0.0001 *** (15.66)	0.0001 *** (14.894)	0.0001 *** (15.205)	0.0001 *** (14.377)	0.0001 *** (13.876)	0.0001 *** (15.078)	0.00001 *** (8.322)	0.0001 *** (13.769)	0.0001 *** (14.266)	0.00001 *** (8.699)	0.00001 *** (8.241)	0.00001 *** (7.527)
African.Am	2.17 (0.513)	−1.05 (−0.247)	1.11 (0.265)	0.09 (0.020)	−1.17 (−0.275)	−0.260 (−0.062)	1.32 ** (2.373)	0.38 (0.092)	0.86 (0.201)	1.10 * (2.019)	1.20 ** (2.153)	1.399 ** (2.488)
Hispanic	2.92 (0.778)	1.53 (0.392)	0.54 (0.145)	0.89 (0.232)	−0.51 (−0.131)	1.56 (0.410)	0.57 (1.154)	0.11 (0.030)	1.94 (0.509)	0.72 (1.508)	0.54 (1.085)	0.66 (1.347)
Age	4.02 (0.26)	−1.46 (−0.091)	−9.60 (−0.620)	−7.74 (−0.482)	−2.20 (−0.138)	−2.55 (−0.162)	−2.41 (−0.851)	0.20 (0.013)	5.24 (0.327)	−0.83 (−0.301)	−2.58 (−0.897)	−1.24 (−0.439)
Income	0.008 (0.925)	0.003 (0.300)	0.005 (0.604)	0.005 (0.549)	−0.004 (−0.426)	−0.0005 (−0.054)	−0.001 (−1.065)	0.007 (0.792)	−0.005 (−0.518)	0.0003 (0.149)	−0.0008 (−0.510)	−0.002 (−1.306)
Education	0.09 (0.006)	−6.46 (−0.402)	−6.43 (−0.420)	−7.55 (−0.475)	−8.85 (−0.554)	−13.56 (−0.853)	0.02 (0.008)	−2.25 (−0.146)	−4.83 (−0.309)	−0.95 (−0.427)	0.28 (0.126)	0.77 (−0.343)
Pop.Density	−0.01 (−0.21)	0.03 (0.896)	0.018 (0.651)	0.027 (0.907)	0.020 (0.668)	0.022 (−0.747)	−0.0001 (−0.028)	0.010 (0.334)	0.02 (0.603)	−0.000 (−0.001)	0.0002 (0.053)	−0.001 (−0.149)
OurTime	−2.49 *** (−2.858)											
Hinge		−1.66 * (−1.70)										
How About We			−2.98 ** (2.685)					−0.32 * (−1.888)				
Grindr				−2.14 * (−1.931)								
At First Sight					−3.12 * (−1.839)							
Adult Friend Finder						−2.59 ** (−2.213)						
Ashley Madison								−2.73 *** (−2.723)				−0.23 * (−1.777)
Facebook									−6.76 ** (−2.36)			
OKCupid										−0.72 ** (−2.256)		
Tinder											−0.46 * (−1.762)	
R-squared	0.916	0.906	0.915	0.908	0.907	0.910	0.827	0.915	0.911	0.834	0.825	0.825
Adj. R-squared	0.900	0.888	0.898	0.890	0.889	0.893	0.783	0.898	0.894	0.792	0.780	0.780
AIC statistic	13.31	13.43	13.33	13.41	13.42	13.38	9.21	13.33	13.37	9.17	9.22	9.22

† t-statistics appear in parentheses; ‡ significant at the 12% level; * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

The population (independent) variable was significant in all models and was positively related to number of cases of Chlamyida, as expected. The variable representing the percent of the state's population that was African American was also positively and significantly related to number of cases of Chlamydia in four of the seven models, as expected, since there is a greater incidence of Chlamydia in the African American population as reported by the CDC.

A greater percent of the population over 65 years of age was found to be associated with a lower number of Chlamydia cases for females, which is also consistent with CDC reports, and higher incomes were found to be associated with a lower number of Chlamydia cases as well for three of the seven models. Higher incomes are typically associated with more education, and these individuals may have more information about the causes and consequences of STDs and may therefore take more precautions to prevent the transmission of STDs.

After controlling for population, race, age, income, education, and population density, two social media sites were found to be positively related to number of Chlamydia cases; Match.com and OKcupid. Match.com allows users to search for a partner by appearance, interests, values, and lifestyle. The web site started in 1995, serves 24 countries, and is typically listed as one of the top five dating sites on the web. OKCupid started its business in 2004. It has members answer a set of questions, and the answers are then matched with the answers of other members to find a compatible partner. While it is free to use the site, paying members avoid advertisements and have more options over their searches for a partner. The results of this study show that, in states where Match.com and OKCupid are more heavily used, people are making connections and the chances of contracting an STD are higher. In particular, the results indicate that, for a 10 unit increase in a state's search volume index for Match.com, there will be 1022 more cases of Chlamydia for females and 391 more cases of Chlamydia for males after controlling for population, race, age, income, education, and population density. For a 10 unit increase in a state's search volume index for OKCupid, there will be 333 more cases of Chlamydia for males after controlling for other factors.

The dating sites Our Time, Ashley Madison, Facebook, and Adult Friend Finder, were found to be inversely related to the number of Chlamydia cases. Our Time is a dating site aimed at an older crowd searching for an older partner, who is perhaps less likely to have an STD and more likely to use protection.

If a state has a larger number of individuals with these traits, as indicated by a larger Google Trends search volume index, it would be expected that there would be fewer cases of Chlamydia, holding population constant.

In the case of Ashley Madison, an individual may be cheating on his or her spouse and may be more inclined to use protection to not bring an STD back home. A larger number of similar individuals as indicated by a larger search volume index in a state for 'Ashley Madison' may therefore be associated with fewer cases of Chlamydia holding population, race, age, income, and population density, constant.

In the case of Adult Friend Finder, members (users) are looking for a sexual relationship. As found by Chan and Ghose (2014) people who are looking for a sexual relationship from places like Craigslist or Backpage are aware of the dangers in the sex industry and are taking appropriate precautions to prevent the contraction of an STD. Members of Adult Friend Finder may very well fit into this category, and thus a higher state search volume index for Adult Friend Finder would be associated with a decrease in Chlamydia cases after controlling for other factors.

While some individuals may be using Facebook to connect with others for a sexual relationship, many are using the social networking site to stay connected with family, relatives, and friends. In the latter case, the group consists of individuals who may be less inclined to engage in several promiscuous relationships and less prone to being a carrier of an STD. Hence, an increase in the size of this group of individuals as indicated by an increase in a state's search volume index for Facebook, would likely lead to a decrease in the number of Chlamydia cases, holding population and other factors constant. This was found to be the case in this study.

Table 3 contains the regression results for eleven Gonorrhea models. All of the variance inflation factors were below five in each model, and no heteroscedasticity was detected. It was found that population, the percent of the state's population that was African American, and population density were all positively related to the number of cases of Gonorrhea, as expected. Age and income were found to be inversely related to the number of Gonorrhea cases, as was also expected. Of the nineteen social media sites analyzed, none of them were significantly related to the number of Gonorrhea cases for females. However, for males, it was found that states with a higher number of users of Match.com and 'Down Dating,' a dating site that is much like Tinder, wherein users can download the app and swipe to reject, date, or have sex with someone they know from Facebook, had higher numbers of cases of Gonorrhea. In particular, for a 10 unit increase in a state's search volume index for Match.com, there were 302 more cases of Gonorrhea for males, as indicated by the results of this study. For a 10 unit increase in a state's search volume index for 'Down Dating', there were 308 more cases of Gonorrhea for males. Lower numbers of Gonorrhea cases were found for states with higher users of Our Time, Hinge, How About We, Grindr, Bumble, Score, Adult Friend Finder, Ashley Madison, and Facebook.

Table 4 contains the results for the Syphilis models. In one model, the Variance Inflation Factor for one independent variable was 6.29, but all other VIFs were below five for every model. No heteroscedasticity was detected in any of the models. None of the social media sites examined in this study had a positive effect on the number of Syphilis cases for males or females, but several had a negative effect, including Our Time, Hinge, How About We, Grindr, At First Sight, Adult Friend Finder, Ashley Madison, Facebook, OKCupid, and Tinder.

5. Discussion

Rhode Island, New Zealand, and southern California have experienced recent outbreaks in STDs. Many health department officials have attributed part of this to the increased use of social media like Tinder, Grindr, and Facebook. The problem, however, when looking at simple correlations between social media use and STDs is that they fail to control for many other socioeconomic variables that can be related to sexual behavior and an increased risk of contracting an STD. In this study, many of these socioeconomic variables were controlled for, including population, race, age, income, education, and population density. It has also been shown by some researchers that the usage of social media may not lead to a higher incidence of STDs but may instead lead to fewer cases of STDs. This is especially true when the users of social media represent either a group that has a low incidence of STDs such as the very young, married, or older individuals or a group that would tend to engage in safe sex practices since they know they are engaging in risky behavior.

One of the early papers to analyze the relationship between social media and sexually transmitted diseases was that by Chan and Ghose (2014). They found a negative relationship between the number of erotic ads placed on Craigslist and the number of HIV cases, implying that prostitution or paid-for sex actually lowered the number of HIV cases. They stated that this may be due to those in the sex industry being more aware of the dangers of unsafe sex and taking appropriate precautions. The authors also found a positive relationship between the number of personal ads on Craigslist and the number of HIV cases due to the increased availability of partners and the ease of connecting with others who were interested in engaging in a sexual relationship. Chan and Ghose concluded that Craigslist has led to a 15.9% increase in HIV cases.

In this study, nineteen social media sites, including dating sites and dating apps, were considered. It was found that those states with more users of Match.com, OKCupid, and Down Dating had a larger number of STD cases after controlling for population, race, age, income, education, and population density. These dating sites and apps are making it easier for men and women to connect with each other, increasing the chances of contracting an STD. On the other hand, those states with more users of Our Time, Ashley Madison, Facebook, Adult Friend Finder, Hinge, How About We, Grindr, Bumble, Score, At First Sight, and Tinder had fewer cases of STDs after controlling for other socioeconomic factors. What this study shows is that, while social media may be allowing individuals to expand

their set of choices of a partner, it does not necessarily result in a higher incidence of STDs. Social networking and dating sites and apps are becoming more and more specialized in the clientele they attract. Some sites are drawing in a crowd that is in search of a long-term relationship, and these individuals are not looking for a short-term sexual relationship that may expose them to an STD. Other sites are drawing in a crowd that is only interested in a short-term sexual relationship, but many of these individuals appear to be engaging in safe sex practices. Future cases of STDs may be reduced not by shutting down social media, dating sites, and apps but by providing more information about the likelihood of contracting an STD from users of different dating sites.

6. Limitations of Study and Future Research

In this study, data at the state level were used. It is possible that, in a particular state, the individuals contracting an STD are different from those using dating apps or social networking sites. If this occurred to a large extent, it would indicate that there is some other factor (other than social media and the control variables, including population, race, age, income, education, and population density) that is responsible for STDs. However, in the regression models for Chlamydia and Gonorrhea, the R-squared statistics were all above 0.98. This indicates that 98 percent of the variation in these STDs across states was explained by the chosen independent variables. Less than two percent of the variation in STDs across states was not accounted for by a social media variable and the control variables. This does not mean that all cases of STDs are linked to social media, but social media has been shown in this study to have a statistically significant effect on the number of STDs after controlling for demographic and economic variables. In the regression models for this study, are there other variables that could explain the remaining two percent variation in Chlamydia and Gonorrhea cases across states that are not explained by the variables used in this study? Perhaps a variable indicating attitudes towards risk-taking behavior or religiosity (or lack of it) could help explain some cases of STDs. Do those individuals who attend church more often have lower rates of STD infections?

The applications used for social interactions are very new, and additional applications are being added constantly. As more data becomes available, it would be useful to create a panel data set to observe the impacts over time.

Another promising area for future research deals with the design and layout of social networking websites and dating apps. Is there a specific web design or feature that triggers individuals who may not engage in safe-sex practices to choose one dating app over another? Are those dating sites with lower membership fees attracting a clientele that are more likely to contract an STD? As new technology in social media emerges, researchers and health officials will face new challenges in attempting to control and manage social diseases.

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