# Depression-related Internet Search Volume as a Correlate of Future Child and Adolescent Suicides : A Cross-correlational Study of Monthly Google Search Volume and Suicide Rate of Young Individuals in the United States

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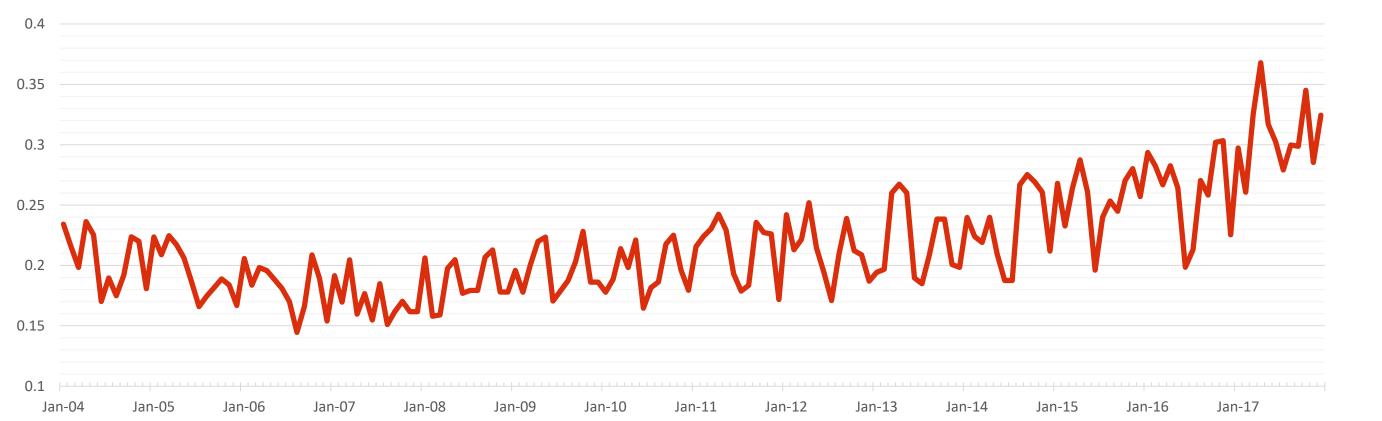
### Background

- Suicide rate among the young people (ages 14-25) in the USA increased about 25% between the years 2000 and 2015<sup>1</sup>
- Using statistical methods with a limited validity, previous studies have examined the suicide-related online searches as a possible correlate of future suicides to produce mixed results<sup>2,3,4</sup>
- However, no study has investigated a correlation between suicide-related Google search volumes and suicide rates among the children and adolescents
- This study examined if the trends in monthly Google search volumes (MGSVs) of any suicide-related search term precede those in monthly suicide rates (MSRs) of people with age 0-19 in the USA

#### Methods

- Search volumes from Google Trends—normalized according to the total number of searches within a designated region and time—reflect the relative popularity<sup>5</sup> MGSVs of 97 suicide-related search terms were obtained by averaging 10 time-
- series data per term for reliability concerns
- MSRs among the U.S. individuals of age 0-19 between 2004 and 2017 were calculated from the U.S. Census Bureau (assumed linear population change between Julys) and the CDC WONDER data (U03.0; U03.9; X60-X84; Y87.0-Y87.2)<sup>3</sup>
- Time-series analysis techniques—including Box-Jenkins' autoregressive integrated moving average (ARIMA) models—were used
- Cross-correlation coefficients between the residual MGSVs and the filtered MSRs were calculated at lags of -1, -2, and -3 months (lag 0 not included in analyses)
- The Benjamini-Hochberg procedure (false discovery rate=0.25) was applied at each lag to minimize false-positive findings innate to multiple comparisons

**Figure 1.** Monthly suicide rate of individuals with age 0-19 in the USA (per 100,000)



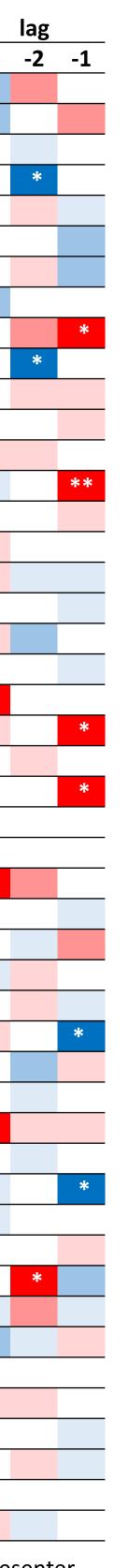
f monthly Google search volumes and suicide rates

Search terms (Short-form) <sup>a</sup>	•
schizophrenia	
schizoaffective	
psychosis	
delusion	
hallucination	
bipolar	
bipolar disorder	
mania	
hypomania	
"bipolar depression"	
"mood disorder"	
hopeless	
depression	
"major depression"	
nostalgia	
anxiety	
"generalized anxiety disorder"	
"anxiety disorder"	
"panic attack"	
"panic disorder"	
·	
phobia cajitation	
agitation "close disorder"	
"sleep disorder"	
sleep problem	
sleep trouble	
"cannot sleep"	
insomnia	
stress	
burnout	
fatigue	
distress	
divorce	
separation	
breakup	
social support	
loneliness	
relationship problem	
trauma	
PTSD	
abuse	
sexual abuse	
verbal abuse	
physical abuse	
mental abuse	
unemployment	
layoff	
fired job	

<sup>a</sup> For full search terms, contact the presenter

	lag		
Search terms (Short-form <sup>a</sup> )	-3	-2	-
suicide (- squad)			
suicides			
suicide ideation			
suicide thought			
suicide attempt			
suicide survivor			
teen suicide			
adolescent suicide			
child suicide			
adult suicide			
commit suicide			
"want to die"			
"how to kill yourself"			
		*	
kill myself			
suicide chat			
how suicide			
suicide way			
suicide method			
assisted suicide			
painless suicide			
where suicide			
suicide poison			
suicide overdose		*	
suicide drug			
drug overdose			
opioid overdose			
alcohol suicide			
Tylenol suicide			
overdose what	*		
suicide gun			
shoot myself			
jump suicide			
hang suicide	*	*	:
hang myself			
suicide note			
suicide site			
suicide help			
suicide hotline			
prevent suicide			
suicide treatment			
suicide clinic			
suicide counseling			
psychiatrist			
psychologist			
psychologist			
relaxation			
CBT			
mental health			
antidepressant			

\* p<0.05 without a Benjamini-Hochberg significance **\*\*** significant correlation per Benjamini-Hochberg procedure



+0.10

-0.15

- +0.05

-0.05

-0.10

#### Results

- MSRs between 01/2004 -12/2017 ranged between 0.144-0.368 per 100,000 individuals with age 0-19 in the USA (Figure 1)
- When Benjamini-Hochberg procedure was applied, MGSVs of only one term ("major depression" + "major depressive disorder" + "unipolar depression" + "MDD") retained a significant correlation with MSRs at lag -1 (Figure 2)

## "An increase in depression-related Google searches precedes an increase in child-adolescent suicides by 1 month"

#### Discussion

- Our result contrasts with the previous finding that MGSVs of anxiety-, sleep-, and unemployment-related—but not depression-related—terms correlated MSRs of the total U.S. population with a 1- to 3-month lag<sup>3</sup>
- Depression-related Internet search-result screens need to be prioritized as a deployment site for child-adolescent-targeted suicide-prevention campaigns Limitations
  - Age- or gender-specific search volumes, lags outside the 1- to 3-month range, non-English searches, and possible confounding factors (e.g., media coverage) of MGSV and MSR were not explored
- Child-adolescent-specific search terms (e.g., ADHD or autism) were not covered
- MGSVs of the term "major depression" may be incorporated in the development of a newer prediction model for child and adolescent suicides

### References

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