



Short communication

Associations of the Stoptober smoking cessation program with information seeking for smoking cessation: A Google trends study

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ABSTRACT

Introduction: The national smoking cessation program Stoptober was introduced in October 2012 in England and in October 2014 in the Netherlands. There is little evidence on the extent to which the Stoptober program has an impact on smoking-related outcomes at national levels. We aimed to measure the magnitude and timing of the associations of the Dutch Stoptober program with searching for smoking cessation on the internet.

Methods: An interrupted time series analysis was used on Google search queries. Data were seasonally adjusted and analyzed using autoregressive integrated moving average (ARIMA) modelling. To examine the magnitude and timing of the program, nine potential intervention periods around early October were analyzed simultaneously, with control for national tobacco control policies. Parallel analyses were made of Belgium as a control group.

Results: The 2014–2016 Dutch Stoptober programs were associated with a significant increase in relative search volume (RSV) in the week the challenge starts (11%, 95% CI: 1–21), the next week (22%, 95% CI: 12–33) and the week afterward (17%, 95% CI: 8–27). A smaller, non-significant increase was observed in the two weeks before the challenge. No substantial increases were found in the Belgian control group.

Conclusions: In the Netherlands, the Stoptober program was associated with a substantial short-term increase in information seeking for smoking cessation. This suggests that Stoptober may be able to affect smoking-related outcomes in national populations at large.

1. Introduction

Tobacco use kills around 6 million people worldwide every year and is the main cause of premature death (World Health Organization, WHO, 2008, 2017). In 2016, the prevalence of cigarette smoking in the Netherlands was estimated at 24.1% (Volksgezondheidzorg.info, 2017). In 2011, 80% of smokers wanted to quit and 26% attempted to quit in the previous year (STIVORO, 2012).

Some studies have shown that mass media campaigns as part of a comprehensive tobacco control program can have a positive effect on smoking behavior (Bala et al., 2017). A specific type of mass media campaign is temporary smoking abstinence campaigns, such as the ‘Stoptober’ program (Brown et al., 2014). In October 2012 this national temporary smoking abstinence program was implemented in England. The program was taken on by the Netherlands and first implemented here in October 2014. The program has continued every year since.

Stoptober challenges smokers to quit for 28 days during the month October and does so by providing participants with an integrated range of positive and supportive messages and services through traditional and social media.

Although the program has been running for several years, the effect of the Stoptober program in the national Dutch population remains unknown, as well as the magnitude and timing of the effect on smoking cessation behavior. Search query data from Google Trends have been shown to be useful in examining population behavior on a national level (Allem et al., 2017; Ayers et al., 2012; Goel et al., 2010). This type of data has been used in studies on the effect of tobacco control policies on online search behavior (Nutti et al., 2014; Troelstra et al., 2016). Online smoking cessation search query data could serve as a tool to measure precursors of quit attempts (Ayers et al., 2014a). The aim of this study was to measure associations of Stoptober with smoking cessation search queries in the Netherlands. We expected a temporal

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increase in smoking cessation search queries that already starts in September, since the program already gains media attention before the official starting date of October first, and smokers might prepare for their challenge in advance.

2. Methods

2.1. Ethics statement

Written confirmation of the Medical Ethics Review Committee was not necessary. The data used in this study on online search behavior was freely available information (in the public domain) and was completely anonymized. The Medical Research Involving Human Subjects Act ('Wet Medisch-wetenschappelijk Onderzoek met mensen') does not apply to this study.

2.2. Analytical design

This study used a quasi-experimental design to examine trends in search queries around Stoptober programs. Three Stoptober programs were included in the analysis: Stoptober 2014, 2015, and 2016. Belgium was added as an extra control group since this country is the most comparable to the Netherlands in terms of language, geography, history and culture (Troelstra et al., 2016). Additionally, the smoking prevalence of the Netherlands and Belgium is comparable (Gisle and Demarest, 2013).

2.3. Data

Search query data were collected directly from <http://www.google.com/trends>. The outcome variable was relative search volume (RSV). RSV measures the total number of searches conducted for a selected query scaled to the total number of Google searches conducted at that point in time. The time period with the highest relative number of searches conducted for the selected query gets assigned a value of 100. Other time periods get assigned a value relative to 100. Since Google Trends only provides data on a weekly scale for a maximum period of 5 years, Dutch and Belgian RSV data of two separate periods, 2007–2012 and 2012 to 2017, were retrieved. The search query 'stoppen met roken', which is the only Dutch equivalent for 'quit smoking' or 'smoking cessation', was used for both the Dutch and Belgian RSV data (Troelstra et al., 2016).

Around each Stoptober program, we constructed nine potential intervention periods, ranging from eight weeks before to eight weeks after the implementation. This method was chosen to minimize the risks of multiple testing. The same method has been used before in other studies using Google Trends data (Troelstra et al., 2016). The week that included October first, i.e., the start of the implementation, was labeled week 0.

2.4. Statistical analysis

In order to create one 10-year period from 2007 to 2017, the values of the first 5-year period were corrected based on the average difference in RSV between the two time periods. To adjust for seasonality, an additive seasonal decomposition was performed on the first 5-year period, when Stoptober was not yet introduced in the Netherlands. The seasonal correction factors estimated for the first time period were also applied to the data for the second period. Next, the two seasonal adjusted series were combined into one seasonal adjusted series that runs from 2007 to 2017.

Time series analyses were used to analyze the associations of the implementation of the Stoptober program. In order to account for dependency between data points in time series, autoregressive integrated moving average (ARIMA) modelling was used. We used the Box-Jenkins approach, which consists of four steps (NIST/SEMATECH, 2003). First,

the data were checked to assess whether or not they were stationary (NIST/SEMATECH, 2003). A log-transformation was performed in order to create a series that is stationary. Second, to identify the appropriate model, initial autoregressive (AR) and moving average (MA) terms were identified by visual examination of the autocorrelation function (ACF) and partial autocorrelation function (PACF) plots. Third, to estimate the model parameters, expert modeler was used to determine the fit of the tentative model. Fourth, the model fit was validated by using the Ljung-Box test and visual inspection of the ACF and PACF residuals (NIST/SEMATECH, 2003). The ARIMA model with the most adequate fit to the Dutch data had two autoregressive terms (ARIMA (2,0,0)) whereas the Belgian model had one autoregressive term (ARIMA (1,0,0)).

Dummy variables of the Stoptober intervention periods were added in order to estimate the associations of the Stoptober program. Estimates were made both for the years 2014–2016 combined and for each separate year. Potentially influential tobacco control policies that were introduced in the two countries during the study period were evaluated using the same nine intervention periods as used to evaluate Stoptober (Troelstra et al., 2016). Intervention periods with a ratio of change in RSV equal to or higher than 1.10 were added to the final models. With these final models, effect sizes and 95% confidence intervals were estimated for the Stoptober program. All analyses were carried out using SPSS 23.

3. Results

Fig. 1 shows RSV data of 'quit smoking' for the Netherlands with the vertical lines indicating the week with the first of January. Large peaks occurred around the first of January of every year in the Netherlands. From 2014 onwards, a second peak emerged around the Stoptober program periods. No October peaks were observed in the Belgian RSV data (data not shown).

In total, six intervention parameters corresponding to three tobacco control policies were added to the Dutch ARIMA model for the Netherlands (Table S1), and three parameters for two policies in Belgium (Table S2). For the Dutch policies, these were week 1 and week 2 after the smoking ban in 2008, week 3–4 and week 5–8 after the introduction of the reimbursement of smoking cessation support (SCS) costs in 2011, and week 1 and 2 after the reintroduction of the reimbursement of SCS costs in 2013. For the Belgian policies, these were week 2 and week 3–4 after the introduction of quitline referencing on tobacco products in 2011, and week 3–4 after the smoking ban in 2011.

Table 1 shows estimates of the associations of the 2014–2016 Dutch Stoptober programs. The Stoptober programs were associated with a significant increase in RSV in the starting week 0 (11%, 95% CI: 1–21), week one (22%, 95% CI: 12–33) and week two (17%, 95% CI: 8–27). A smaller and non-significant increase was also observed two weeks (6%, 95% CI: –2 to 14) and one week before the implementation (7%, 95% CI: –1 to 17). No such changes were observed during these periods in the Belgian RSV.

In all three separate years, a substantial increase in the Dutch RSV occurred up to two weeks after the implementation, with part of them being statistically significant. The highest peak was observed one week after the start of the 2014 Stoptober program (Table S3).

4. Discussion

4.1. Main outcomes

Overall, the Stoptober program was associated with a significant increase in RSV from the starting week of the challenge until two-weeks afterward. This increase was about as large as the increase seen around the first of January. During the Dutch Stoptober program, no similar increase occurred in the Belgian control group.

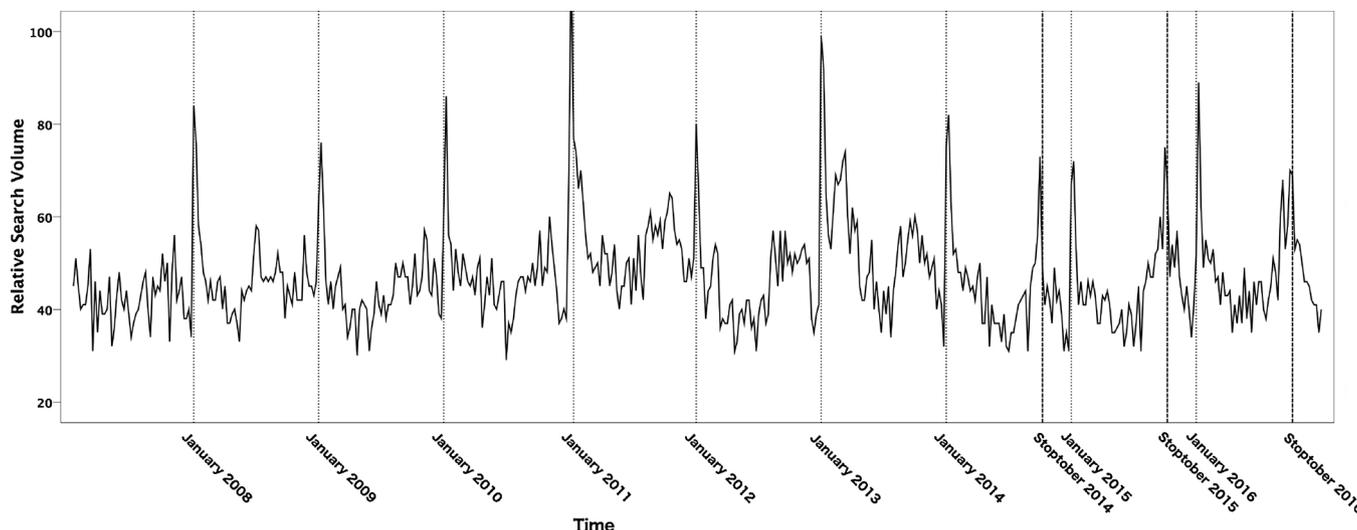


Fig. 1. Google Trends relative search volume (RSV) data for smoking cessation ('stoppen met roken') for the Netherlands measured on a weekly scale from January 2007 to January 2017.

Table 1

Relative search volume (RSV) for smoking cessation ('stoppen met roken') before and during the 2014, 2015 and 2016 Stoptober campaigns as compared to the rest of these years, the Netherlands (intervention country) and Belgium (control country).

	The Netherlands		Belgium	
	RSV ratio ^a	95% CI	RSV ratio ^a	95% CI
Weeks before implementation				
5–8	1.00	(0.95–1.05)	1.02	(0.98–1.05)
3–4	0.96	(0.90–1.03)	1.01	(0.96–1.06)
2	1.06	(0.98–1.14)	1.04	(0.98–1.10)
1	1.07	(0.99–1.17)	0.98	(0.92–1.04)
Week with the first of October	1.11*	(1.01–1.21)	1.02	(0.96–1.08)
Weeks after implementation				
1	1.22*	(1.12–1.33)	0.96	(0.91–1.02)
2	1.17*	(1.08–1.27)	0.94	(0.89–1.00)
3–4	1.02	(0.95–1.10)	0.99	(0.95–1.04)
5–8	1.02	(0.97–1.07)	1.00	(0.96–1.03)

CI: confidence interval

* Statistically significant at $p < 0.05$.

^a An ARIMA (autoregressive integrated moving average) model with two autoregressive terms was used for the Dutch data, and with one autoregressive term for the Belgian data. RSV ratios were estimated by comparing implementation periods to all other time periods in the same country. Results were corrected for seasonality and relevant tobacco control policies.

4.2. Evaluation of study limitations

The timing of the associations could not be estimated with great precision. First, RSV data were available at on weekly scale instead of single days. Secondly, the use of two autoregressive terms in the Dutch ARIMA model can cause the estimated associations to be spread out over time. Due to the two autoregressive terms and the increase in RSV in the last September week, the peak in the starting week may have been underestimated.

A potential limitation to online search query data is their representativeness for the national population. However, in the Netherlands, adults over 60 years are equally likely to use the internet to acquire health-related information compared to adolescents (Ayers et al., 2014b). Moreover, the percentage of the adult population that has access to the internet is very high (94% in 2016) among all age groups in the Netherlands (Statistics Netherlands, 2016).

4.3. Interpretation of results

We found a substantial increase in search queries around the time of the implementation of the Stoptober program. This increase may reflect the program's considerable efforts to reach the national population. A combination of traditional media, social media, and some celebrity ambassadors was used in order to build interest and engagement among the national population (Brown et al., 2014). Moreover, messages may have been readily accepted thanks to their essentially positive contents. Finally, since much of the Stoptober program is internet-based, the step towards online searching for information on smoking cessation may have been small for those who were reached.

It is uncertain whether the increase in smoking cessation search queries during Stoptober reflects an increase in other ways of smoking cessation. Increased frequencies of search queries are likely to reflect increased population-wide interest and engagement (Prochaska and Velicer, 1997). Other studies on internet search queries showed that these forecast population-wide trends in smoking cessation (Ayers et al., 2015; Santillana et al., 2014). Based on the Transtheoretical Model of Health Behavior Change, such interest and engagement may foreshadow action. With regard to smoking, such a trend is likely. An English evaluation of the effects of the 2012 Stoptober program in a nationally representative study population observed a 4.15% increase in quitting during the month of the Stoptober program (Brown et al., 2014).

4.4. Conclusions

The study showed that the implementation of the Stoptober smoking cessation program was associated with a short-term increase in online searching for information about smoking cessation. This adds evidence on the potential of temporary smoking abstinence programs to have population-wide impacts.

Contributors

AT performed data collection, statistical analysis and wrote the initial draft of the manuscript. SAT and AEK developed the study concept. AT and SAT wrote the final draft of the manuscript. TH oversaw the statistical analysis and provided critical feedback. AEK obtained funding for the study and oversaw all proceedings. All authors contributed to study design and interpretation of the results, and have approved the final manuscript.

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Conflict of interest

No conflict declared.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.drugalcdep.2018.08.040>.

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