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**Brief Communications**

**Cigarette Taxation and the Searching Popularity of Electronic Cigarettes**

## **Abstract**

**Background:** Increase in cigarette prices may cause people to resort to electronic cigarettes as substitutes. We investigated whether price hike in cigarettes would evoke public interest in electronic cigarette.

**Methods:** The data from 'Google Trends' were collected. The search queries for both 'cigarette price' and 'electronic cigarette' were analyzed during the period of January 2006 to December 2016. We inputted 'cigarette price (dambaegap in Korean)', and added 'electronic cigarette (jeonjadambae in Korean)'.

**Results:** Three remarkable spikes for both electronic cigarette searches and cigarette price searches were noted in 2010, 2012, and 2014 to 2015. The peaks of the cigarette price searches were followed by the peaks of electronic cigarette searches.

**Conclusion:** Raising cigarette prices were related to increased interest in the online searches for electronic cigarettes. Price regulation of electronic cigarette might be considered simultaneously to prevent unexpected use of electronic cigarette accompanied by tax increase of cigarette smoking.

**Keywords:** Cigarette Price; Electronic Cigarette; Google Trend; Search

## Introduction

Smoking related morbidity and mortality are of great concern worldwide.(1) In Korea, cigarette smoking is a major cause of preventable diseases and responsible for more than 365,000 deaths yearly.(2, 3)

Raising cigarette price is considered an effective way to decrease smoking rate. The World Health Organization (WHO) concluded that raising the taxes and prices of cigarettes was the single most effective and cost-efficient intervention to curb smoking.(4) Many countries have increased taxes on cigarettes to make cigarettes costly so that people are obliged to quit smoking in order to avoid financial burden. In Korea, along with other various anti-smoking policies, cigarette tax increase in 2001, 2002, 2005 and 2015 substantially attributed to the decrease of smoking prevalence in Korea,(5) resulting changes in the male adult smoking rate from 70% in the early 1990s to 39% in 2015.(6, 7)

An **electronic cigarette** or **e-cigarette** is a handheld electronic device which vaporizes a flavored liquid. The modern electronic cigarette was invented in 2003 in China,(8) and was introduced to Korea in 2007.(9) It is often portrayed as a safer and cheaper alternative to a regular conventional cigarette or as a smoking cessation aid by healthcare providers and the media and even by smokers themselves.(8, 10, 11) According to market economy theories, an increase in price of a certain goods will result in an increase in demand for its substitute goods. In a similar vein, it is plausible that increase in cigarette prices will cause people to resort to electronic cigarettes as substitutes. However, no study has examined such relations.

In this study, we investigated whether price hike in cigarettes would evoke public interest in electronic cigarettes by relating the trend of internet search queries for 'cigarette price' and 'electronic cigarette' simultaneously.

## Data and Methods

The data were collected from 'Google Trends' (<https://trends.google.com/trends/>). 'Google Trends' is a real-time free internet search analysis tool that provides data on the relative popularity of search terms. It shows how frequently a particular search term is entered into Google's search engine relative to the total search volume. It can be used to check out latest trends and data, provide visualization of information, and to introduce hot issues. It presents a value of 'interest over time' ranging from 0 to 100. The value of 100 represents the peak popularity, in other words, peak search volume for the search term, and it shows the highest search interest for a specific region and time period. The value 50 indicates half the popularity of the query, while 0 indicates that the popularity of the query is less than 1% as popular as the peak.

The search queries for both 'cigarette price' and 'electronic cigarette' were analyzed during the period of January 2006 to December 2016. At first, we inputted 'cigarette price (*dambaegap* in Korean)', and added 'electronic cigarette (*jeonjadambae* in Korean)'. The search area was restricted to South Korea.

## Results

Figure 1 shows the trend of cigarette price and electronic cigarette searches. The electronic cigarette searches were minimal before 2007, when the electronic cigarettes were first introduced in Korea, and remained very low in frequency until early 2010. However, three remarkable spikes for both electronic cigarette searches and cigarette price searches were noted in 2010, 2012, and 2014 to 2015. The peaks of the cigarette price searches were followed by the peaks of electronic cigarette searches.

## Discussion

We observed three peaks of 'cigarette price' searches in 2010, 2012, and 2014 to 2015. In 2010, the government announced its consideration of raising cigarette taxes after the 2010 smoking survey, but was met with resistance due to lack of social consensus.(12) In early 2012, the prices for the imported cigarettes were raised by 8%.(13) In September 2014, the government announced to impose a tax increase starting from January 2015, that took the price of cigarettes to almost double.(14) In all the three peak periods, search for 'cigarette price' was accompanied by search for 'electronic cigarette'.

Online searches for electronic cigarettes may not be necessarily followed by an actual use of electronic cigarettes. However, those who made searches on electronic cigarettes are likely to be exposed to information claiming that electronic cigarettes are a cheaper and healthier alternative to conventional cigarettes. This can consequently lead the searchers to actually switch to or begin using electronic cigarettes. The use of electronic cigarettes has indeed increased just recently in Korea. A study in 2013 found that 1.1% of Korean adults reported to be current users of electronic cigarettes while about 6.6% were ever users.(15) The sales of electronic cigarettes increased significantly as well. G-Market, the biggest online shopping mall in Korea by sales, reported a 16-fold jump in electronic cigarette sales in December 2014, compared to the same month in 2013,(16) which supports our hypothesis.

While still preliminary, our finding has important implications from a public health perspective. While setting a high price for cigarettes was thought to be effective in reducing smoking rate, policy makers should also consider in mind that implementation of such cigarette price hikes can induce unexpected increase in the use of electronic cigarettes. Electronic cigarettes may be

theoretically safer than regular cigarettes, but caution is still needed due to its potential toxicity, questionable quality standards for manufacture or adequacy and consistency in nicotine delivery, and the unknown long-term effect of propylene glycol inhalation. World Lung Foundation and World Medical Association currently warn against electronic cigarette use.(17)

In addition, when considering the increasing use of electronic cigarettes in adolescents, the safety issue of electronic cigarettes and the need to restrict access to electronic cigarette in adolescents are very important.(18, 19)

One of the ways to avoid such 'balloon effect' is a simultaneous increase in the electronic cigarette prices. Since electronic cigarettes seem to be a cheaper and comfortable alternative to conventional cigarettes.(8, 10, 11), it would be essential to increase electronic cigarette taxes and prices to avoid conventional cigarette smokers turning to electronic cigarettes.(20) However, as some smokers use electronic cigarettes as assistance to quit smoking,(8, 11) tax increase in electronic cigarettes should be cautiously adjusted not to discourage conventional cigarette smokers who switch to electronic cigarettes for such purpose.(20) Enforcement of medical device regulations including childproof safety and labeling of ingredients, adverse effects and health warning can be another measure to avoid the unwanted popularity of electronic cigarettes.(21)

In conclusion, we identified that raising cigarette prices were related to increased interest in the online searches for electronic cigarettes. It is necessary to address the issues related to the electronic cigarette use and cigarette tax policy. Especially, price regulation of electronic cigarette might be considered simultaneously to prevent unexpected use of electronic cigarette accompanied by tax increase of cigarette smoking.

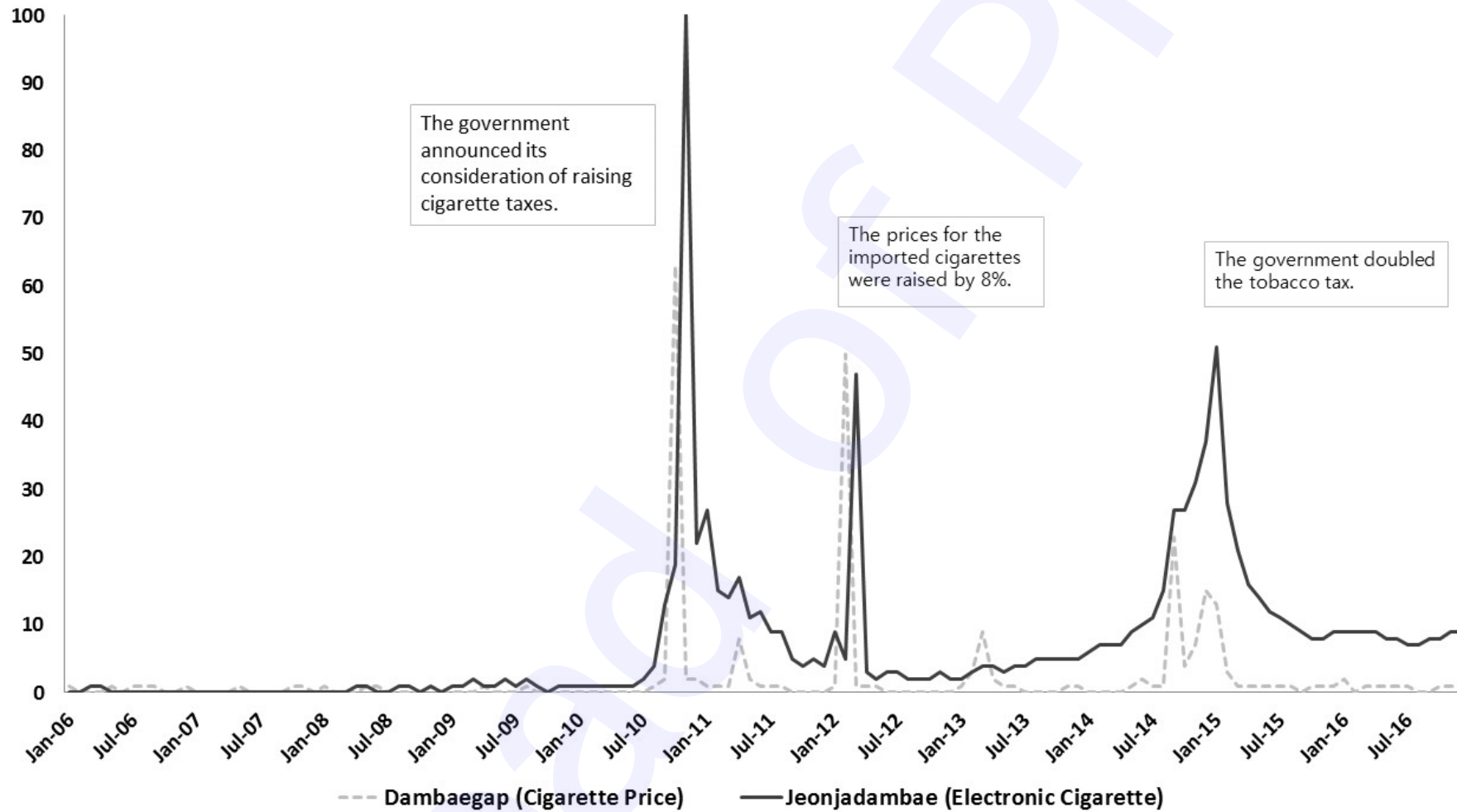


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Figure 1. The trend of cigarette price and electronic cigarette searches during the period of January 2006 to December 2016.



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