A study on nicotine addiction among conventional cigarette smokers and electronic cigarette users during Ramadhan fasting month in Klang Valley, Malaysia

Shazzihan Solhi¹, Fauziah Zamri¹ and Masro Mohamad¹*

¹Department of Pharmaceutical Sciences, Faculty of Pharmacy, University of Cyberjaya, Cyberjaya 63000, Selangor, Malaysia

*Corresponding author:
Tel.: +6014-7171737
E-mail address: masro@cyberjaya.edu.my

ABSTRACT

The study was conducted to compare nicotine addiction among conventional cigarette smokers and electronic cigarette (e-cigarette) users during fasting and non-fasting month in Klang Valley, Malaysia. The study involved 69 conventional cigarette smokers and 41 e-cigarette users. Their nicotine dependence levels were measured using Fagerstrom Test for Nicotine Dependence (FTND) and Cigarette Dependence Scale (CDS). The amount of nicotine intake was estimated and the levels of exhaled carbon monoxide (COppm) were taken using Smokerlyzer®. The mean FTND score was significantly increased during fasting month among both conventional cigarette smokers and e-cigarette users compared to during non-fasting month. The comparison of FTND score between conventional cigarette smokers and e-cigarette users during fasting and non-fasting month showed no significant difference. The mean of CDS score was significantly decreased among conventional cigarette smokers but was significantly increased among e-cigarette users during
fasting month as compared to non-fasting month. The mean of CDS score was significantly higher among conventional cigarette smokers when compared to the e-cigarette users during non-fasting month but there was no difference during fasting month. The estimated nicotine intake has significantly decreased during fasting month in both conventional cigarette smokers and e-cigarette users as compared to non-fasting month. The estimated nicotine intake was significantly lower among e-cigarette users when compared to the conventional cigarette smokers during both non-fasting and fasting months. The levels COppm of all the respondents were significantly decreased during fasting month. Lastly, the e-cigarette users showed a significantly lower COppm when compared to the conventional cigarette smokers during non-fasting and fasting month. In conclusion, Ramadan fasting increased nicotine dependence among both the conventional cigarette smokers and the e-cigarette users.

(Word Count: 271)
ABBREVIATIONS

E-Cigarette  Electronic cigarette
FTND  Fagerstrom Test for Nicotine Dependence
CDS  Cigarette Dependence Scale
CO  Carbon monoxide

KEYWORDS: Ramadan fasting month, conventional cigarette smokers, electronic cigarette users, Fagerstrom Test for Nicotine Dependence, Cigarette Dependence Scale, carbon monoxide
INTRODUCTION

Ramadan is the ninth month of the Islamic calendar, which is considered the holiest month of the 12-month calendar. During the month of Ramadan, Muslims throughout the world restrain themselves from eating, drinking and involving in conjugal relationships beginning from sunrise until sunset for a duration of 29–30 days.\(^1\) Besides restraining from eating and drinking, Muslims are also restricted from smoking from dawn to dusk during the Ramadan fasting month.\(^2\) Thus, Ramadan fasting month could be the perfect time to evaluate the change in nicotine addiction level.

In a study by Ziaee et al.\(^3\), Ramadan fasting was shown to reduce glucose levels and weight. Ramadan fasting was also suggested to be useful in improving the risk score of coronary heart disease and also other cardiovascular risk factors.\(^4\)

Although these findings showed that Ramadan fasting was able to improve various diseases or conditions, nicotine dependence was not shown to be reduced in cigarette smokers. The desire to smoke is increased for smokers when they are restrained from food, which will be difficult for the smokers.\(^2\) A study showed preliminary evidence that the intake of nicotine and smoking rate in humans increase during sustained food deprivation.\(^5\) Contrary to this, a study done in Malaysia found that there are significant effects of fasting in reducing smoker’s nicotine dependency.\(^6\)

Therefore, the assessment of the change in nicotine dependence level during Ramadan fasting month will be able to depict more clearly how the fasting affects nicotine dependence level among conventional cigarette smokers and electronic cigarette (e-cigarette) users.
The addiction of smokers to their cigarettes is caused by nicotine, which is the vital chemical compound in a cigarette or any commercial tobacco products. Furthermore, the strong addicting effects of cigarettes are also maintained or prolonged by the nicotine.\textsuperscript{7}

In addition to cigarettes, e-cigarettes are also available in the market, which also contain nicotine as a conventional cigarette. Nicotine is delivered by e-cigarette in the form of aerosol (commonly known as vapour) to users. E-cigarette is described as an electronic atomization cigarette that acts as cigarette substitutes.\textsuperscript{8} Nowadays, e-cigarettes are considered as increasingly popular and a famous trend among adolescents.\textsuperscript{9}

Hence, the evaluation of nicotine dependence level among e-cigarette users is of great importance alongside the conventional cigarette smokers. Furthermore, assessments of nicotine dependence among conventional cigarette smokers and e-cigarette users are also considered to be lacking especially during Ramadan fasting month. In addition, the findings of this study can be used by health care professionals, academicians, conventional cigarette smokers, e-cigarette users and also the public.
MATERIALS AND METHODS

The study was done at several shopping malls and also a few restaurants in Klang Valley during Ramadan fasting month in 2015. Sixty-nine conventional cigarette smokers and 41 e-cigarette users have participated as respondents.

This study involved 2 sets of cross-sectional data collection on the same respondents; in which 1 set of the data collection was done during a fasting month and the other set was done during a non-fasting month. In order to compare and determine the nicotine dependence in the respondents, Fagerstrom Test for Nicotine Dependence (FTND) and Cigarette Dependence Scale (CDS) were incorporated as part of the questionnaire. The FTND and CDS were adopted and adapted from Heatherton et al.\textsuperscript{10} and Etter et al.\textsuperscript{11} respectively.

In addition to the FTND and CDS, a few questions were also incorporated as part of the questionnaire to calculate the estimated nicotine intake in a month. The levels of carbon monoxide (COppm) in breath were also taken from each respondent during the fasting and non-fasting month using a Smokerlyzer\textsuperscript{®}.

This study was conducted from the 27\textsuperscript{th} of June 2015 until the 16\textsuperscript{th} of July 2015 during the fasting month and then, was continued from the 27\textsuperscript{th} of July 2015 until the 21\textsuperscript{st} of August 2015 to collect the data for the non-fasting month.
Paired t-test was used to compare the mean of score of FTND, CDS, COppm and %COHb between fasting and non-fasting month among both the conventional cigarette smokers and the e-cigarette users. Independent t-test was used in comparing the mean of score of FTND, CDS, COppm and %COHb between the conventional cigarette smokers and the e-cigarette users during both fasting and non-fasting month.

Wilcoxon Signed Ranks Test was used to compare the median of estimated nicotine intake between fasting and non-fasting month among both the conventional cigarette smokers and the e-cigarette users. Mann-Whitney Test was used in comparing the median of estimated nicotine intake between the conventional cigarette smokers and the e-cigarette users during both fasting and non-fasting month.
RESULTS

Table 1 shows that FTND score was significantly increased during fasting month for both the conventional cigarette smokers and e-cigarette users. Table 1 also shows that there was no significant difference in FTND score between the conventional cigarette smokers and the e-cigarette users during both fasting and non-fasting month.

CDS score was significantly reduced among conventional cigarette smokers during fasting month but significantly increased among e-cigarette users during fasting month as shown in Table 1. There was no significant difference in CDS score between the conventional cigarette smokers and the e-cigarette users during fasting month but the e-cigarette users showed a significantly lower CDS score than the conventional cigarette smokers during non-fasting month as shown in Table 1.

Table 2 shows that nicotine intake was significantly reduced during fasting month for both the conventional cigarette smokers and e-cigarette users. Table 2 also shows that the nicotine intake of the e-cigarette users was significantly lower than that of the conventional cigarette smokers during both fasting and non-fasting month.

Table 3 shows that COppm was significantly reduced during fasting month for both the conventional cigarette smokers and e-cigarette users. Table 3 also shows that the COppm of the e-cigarette users was significantly lower than that of the conventional cigarette smokers during both fasting and non-fasting month.
DISCUSSION

The results of FTND score among conventional cigarette smokers showed that, the conventional cigarette smokers had a significantly higher FTND score during fasting month if compared to non-fasting month, which indicates an overall increase in nicotine dependence during fasting month among the conventional cigarette smokers.

This shows that fasting increases nicotine dependence as indicated by the FTND score. This is consistent with previous studies, which stated that food deprivation increases nicotine dependence.\textsuperscript{5,12} Similarly with the conventional cigarette smokers, fasting also increases nicotine dependence in e-cigarette users as indicated by the FTND score.

In the current study, the FTND score of e-cigarette users during non-fasting month was lower than the FTND score of the conventional cigarette smokers during non-fasting month. However, the difference was not significant, which could be due to low sample size of the conventional cigarette smokers. In previous studies, nicotine dependence was shown to be lower in e-cigarette users.\textsuperscript{13,14} Similarly with the conventional cigarette smokers and e-cigarette users in non-fasting month, the FTND score of conventional cigarette smokers in fasting month showed no significant difference if compared to the FTND score of e-cigarette users in fasting month. This means that the amount of increase in nicotine dependence during fasting month is the same in both conventional cigarette smokers and e-cigarette users.
The total score of CDS of the conventional cigarette smokers showed a significant reduction during fasting month if compared to non-fasting month, which indicates a total reduction in nicotine dependence during fasting month. This finding is inconsistent to the finding of FTND score among conventional cigarette smokers between fasting and non-fasting month. This could be due to the difference in the aspects of nicotine dependence that were measured between FTND and CDS. Similar with FTND score, fasting also increases nicotine dependence in e-cigarette users as indicated by the CDS score.

The CDS score of the conventional cigarette smokers was shown to be significantly higher if compared to the CDS score of the e-cigarette users in non-fasting month, which indicates that, e-cigarette users have a lower nicotine dependence than the conventional cigarette smokers. The CDS score of the conventional cigarette smokers in fasting month showed no significant difference if compared to the CDS score of the e-cigarette users in fasting month, which indicates that, there is no difference in the nicotine dependence of the conventional cigarette smokers and the e-cigarette users. This means that, the increase in nicotine dependence during fasting month was higher among e-cigarette users if compared to the increase in nicotine dependence among conventional cigarette smokers.

Finding of the current study showed that, the total estimated nicotine intake was significantly reduced during fasting month if compared to non-fasting month, which indicates a total reduction in the amount of cigarettes smoked per month. The decrease in nicotine intake could be due to the limited time to smoke and the effect of Ramadan fasting itself to their daily life events. This finding is consistent with a previous study. Based on the finding of the current study,
the total estimated nicotine intake was found to be significantly reduced during fasting month if compared to non-fasting month, which indicates a total reduction in the amount (volume) of e-liquid used per month during fasting month. This shows that e-cigarette users also showed similar trend as conventional cigarette smokers.

In the current study, the conventional cigarette smokers in non-fasting month had shown a significantly higher amount of nicotine intake if compared to the amount of nicotine intake of the e-cigarette users in non-fasting month, which indicates that the use of e-cigarette will lead to a lower nicotine intake if compared to conventional cigarette. This shows that the use of e-cigarette will lead to a lower nicotine intake. This finding is consistent with a previous study.16 Similarly with the conventional cigarette smokers and the e-cigarette users in non-fasting month, the conventional cigarette smokers in fasting month showed a significantly higher amount of nicotine intake if compared to the amount of nicotine intake of the e-cigarette users in fasting month. This indicates that, the use of e-cigarette in fasting month will also lead to a lower nicotine intake if compared to conventional cigarette.

According to the finding of the current study, all of the conventional cigarette smokers who participated in the Smokerlyzer® analysis, which involved 58 (84%) of them had shown a significant reduction in COppm levels during fasting month if compared to non-fasting month, which indicates an overall decrease in the frequency of smoking during fasting month.

Similarly with the conventional cigarette smokers, all of the e-cigarette users who participated in the Smokerlyzer® analysis, which involved 26 (63%) of them had shown a
significant reduction in the total COppm levels during fasting month if compared to non-fasting month, which indicates an overall decrease in the frequency of using e-cigarette during fasting month.

The current finding showed that the total COppm levels of the conventional cigarette smokers during non-fasting month was significantly higher if compared to the e-cigarette users during non-fasting month, which indicates that the use of conventional cigarettes resulted in the increase of expired air CO concentration. In a previous study, it was demonstrated that e-cigarettes did not increase exhaled air CO concentration while conventional cigarettes increased CO levels in exhaled air as expected.\textsuperscript{17}

Similarly with the conventional cigarette smokers and the e-cigarette users in non-fasting month, the total COppm levels of the conventional cigarette smokers in fasting month was significantly higher if compared to the e-cigarette users in fasting month. This indicates that the conventional cigarettes resulted in the increase of expired air CO concentration in fasting month as well.

There were several limitations in this current study. Firstly, the sample size was lower than the required, which could be due to the short duration of data collection during fasting month. The data collection can only started after 10 days of fasting, which reduced the duration of data collection in the fasting month to 20 days only. Moreover, the Muslims only started to go out to the public places such as shopping malls and restaurants after sunset to break the fast and after they performed their Tarawih prayers. This limitation could be overcome by expanding the
locations, where possible respondents could be found. A few of the possible participants were also underage, which excluded them from the study.

The next limitation is the Smokerlyzer® analysis. The levels of CO measured can be easily increased by exposure of the respondents to the polluted air from smoke of cars, busses or lorries. Therefore, indoor places should be preferred if the Smokerlyzer® analysis were to be used in the future.

CONCLUSION

This present study showed that, Ramadan fasting caused an increase in the nicotine dependence among both the conventional cigarette smokers and the e-cigarette users. However, the increase in nicotine dependence was more obvious among the e-cigarette users than the conventional cigarette smokers. Although the increase in nicotine dependence in the e-cigarette users during the fasting month was more obvious, the nicotine intake in a month and the CO level was significantly lower in e-cigarette users as compared to the conventional cigarette smokers.
REFERENCES


Table 1: The comparison on the score of FTND and CDS among conventional cigarette smokers and e-cigarette users between fasting and non-fasting month.

<table>
<thead>
<tr>
<th></th>
<th>Conventional</th>
<th>E-Cigarette</th>
<th>P value*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FTND</td>
<td>CDS</td>
<td>FTND</td>
</tr>
<tr>
<td>Non-Fasting</td>
<td>3.42&lt;sup&gt;a,b&lt;/sup&gt;</td>
<td>14.75&lt;sup&gt;c,g&lt;/sup&gt;</td>
<td>3.02&lt;sup&gt;b,c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Fasting</td>
<td>4.04&lt;sup&gt;a,d&lt;/sup&gt;</td>
<td>13.94&lt;sup&gt;c,h&lt;/sup&gt;</td>
<td>3.51&lt;sup&gt;b,d&lt;/sup&gt;</td>
</tr>
<tr>
<td>P value&lt;sup&gt;*&lt;/sup&gt;</td>
<td>0.001&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.009&lt;sup&gt;e&lt;/sup&gt;</td>
<td>0.042&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

*Independent t-test, statistically significant if P < 0.05

Table 2: The comparison on the estimated nicotine intake in one month among conventional cigarette smokers and e-cigarette users between fasting and non-fasting month.

<table>
<thead>
<tr>
<th></th>
<th>Conventional</th>
<th>E-Cigarette</th>
<th>P value&lt;sup&gt;*&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FTND</td>
<td>CDS</td>
<td>FTND</td>
</tr>
<tr>
<td>Non-Fasting</td>
<td>600&lt;sup&gt;k&lt;/sup&gt;</td>
<td>270&lt;sup&gt;k&lt;/sup&gt;</td>
<td>&lt;0.001&lt;sup&gt;l&lt;/sup&gt;</td>
</tr>
<tr>
<td>Fasting</td>
<td>360&lt;sup&gt;i,l&lt;/sup&gt;</td>
<td>180&lt;sup&gt;j,l&lt;/sup&gt;</td>
<td>&lt;0.001&lt;sup&gt;j&lt;/sup&gt;</td>
</tr>
<tr>
<td>P value&lt;sup&gt;*&lt;/sup&gt;</td>
<td>&lt;0.001&lt;sup&gt;i&lt;/sup&gt;</td>
<td>&lt;0.001&lt;sup&gt;j&lt;/sup&gt;</td>
<td></td>
</tr>
</tbody>
</table>

*Mann-Whitney Test, statistically significant if P < 0.05

Table 3: The comparison on the level of COppm among conventional cigarette smokers and e-cigarette users during fasting and non-fasting.

<table>
<thead>
<tr>
<th></th>
<th>Conventional</th>
<th>E-Cigarette</th>
<th>P value&lt;sup&gt;*&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FTND</td>
<td>CDS</td>
<td>FTND</td>
</tr>
<tr>
<td>Non-Fasting</td>
<td>17.90&lt;sup&gt;m,o&lt;/sup&gt;</td>
<td>9.50&lt;sup&gt;n,o&lt;/sup&gt;</td>
<td>&lt;0.001&lt;sup&gt;n&lt;/sup&gt;</td>
</tr>
<tr>
<td>Fasting</td>
<td>12.90&lt;sup&gt;m,p&lt;/sup&gt;</td>
<td>7.58&lt;sup&gt;e,p&lt;/sup&gt;</td>
<td>&lt;0.001&lt;sup&gt;p&lt;/sup&gt;</td>
</tr>
<tr>
<td>P value&lt;sup&gt;*&lt;/sup&gt;</td>
<td>&lt;0.001&lt;sup&gt;m&lt;/sup&gt;</td>
<td>&lt;0.001&lt;sup&gt;n&lt;/sup&gt;</td>
<td></td>
</tr>
</tbody>
</table>

*Independent t-test, statistically significant if P < 0.05

Paired t-test, statistically significant if P < 0.05