Compensatory puffing behaviour in e-cigarette users: Blood nicotine delivery and subjective effects

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Declarations

• Conducted research for e-cigarette companies (2010-2013)
• Consultant for pharmaceutical industry (2014)
• Expert witness in e-cigarette patent infringement case (2014)
• No funding from tobacco industry
Self-Titration in Smokers

- Smokers adjust their nicotine intake to maintain a personal optimal level.
- Smokers can achieve approx. 60-80% of their ordinary nicotine intake (Scherer & Lee, 2014).
- Mainly via taking longer, harder drags and more frequent puffs.
- Switching to ‘light’ or reduced nicotine containing cigs doesn’t appear to reduce toxicant exposure and may even increase it.
Nicotine boost of 4.7ng/mL after 10 mins (10 puffs). Cmax = 13.9ng/mL at 60 mins.

Dawkins & Corcoran (2014)
Individual nicotine levels

Nicotine ng/ml of blood

baseline 10 mins after 10 puffs 15 mins ad lib vaping 30 mins/vaping 45 mins/vaping 60 mins/vaping 60 mins rest
TPD Article 20

- Limit on nicotine concentrations > 20mg/mL
- 9% use above 20mg/mL (ASH, 2016)
- 1/5th of e-cig users *initiated* vaping with >20mg/mL nicotine concentration (Farsalinos et al., 2013)
To explore:

1. the extent to which e-cigarette users self-titrate when given a lower nicotine concentration liquid

2. subjective effects (craving, withdrawal symptoms, positive and negative effects) and plasma nicotine concentrations between conditions (high vs. low nicotine concentration liquid)
Methods

- **Participants**: 11 male experienced e-cig users
- **E-cigarette**: eVic Supreme (Joyetech) with Aspire tank (Nautilus)
- **E-liquid**: 6 & 24mg/mL tobacco flavour (Halo Smokers’ Angels)
- **Double-blind, counterbalanced**
Procedure

Pre-study Screening → Overnight abstinence → baseline → 10 mins → 30 mins → 60 mins

Salivary cotinine > 100ng/mL → Blood Craving Withdrawal symptoms → Blood Craving Withdrawal symptoms Puffing topography → Blood Craving Withdrawal symptoms Puffing topography → Blood Craving Withdrawal symptoms Puffing topography Positive & negative effects

Ad lib vaping

Repeated under high and low nicotine concentration conditions
More puffs, longer puffs and more liquid consumed in the low (6mg/mL condition (p < 0.05)
Incomplete self-titration from compensatory puffing
Blood nicotine/puffing topography correlations

High: $r = 0.85^{**}$; Low: $r = 0.75^{**}$

High: $r = 0.56^*$; Low: $r = 0.22$

** $p < 0.01$; * $p < 0.05$
Subjective effects

No significant differences between conditions in urge to vape or withdrawal symptoms.
Positive Effects

Trend for higher ratings of hit and satisfaction in the high nicotine condition ($p = 0.11$ & $p = 0.09$)
Conclusions

• Clear evidence of compensatory puffing with lower nicotine concentration e-liquid
• Self-titration was partially effective…
• … equivalent reduction in urge to vape and withdrawal symptoms across conditions…
• …but significantly higher levels of blood nicotine in the high condition
• Very high levels of nicotine can be achieved very quickly (equivalent to smoking) under certain conditions
Implications

• Self-titration – another attractive feature of vaping?

• More e-liquid consumed = higher cost (Kimber et al., 2016)

• Advise smokers to use a higher nicotine strength liquid?

• Limiting nicotine concentrations in e-liquid (TPD; May 2016) not necessarily the best option.

• Blood nicotine levels akin to smoking may improve smoking cessation rates but prolong nicotine addiction
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