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Electronic cigarette smoking increases aortic stiffness in young smokers

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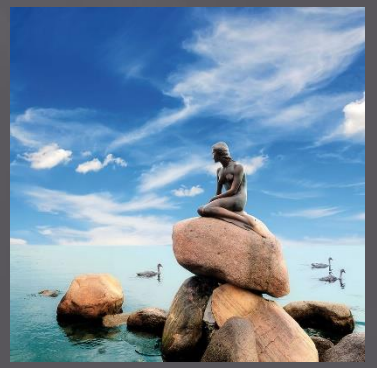


Disclosure

No conflict of interest.

Methods

Results

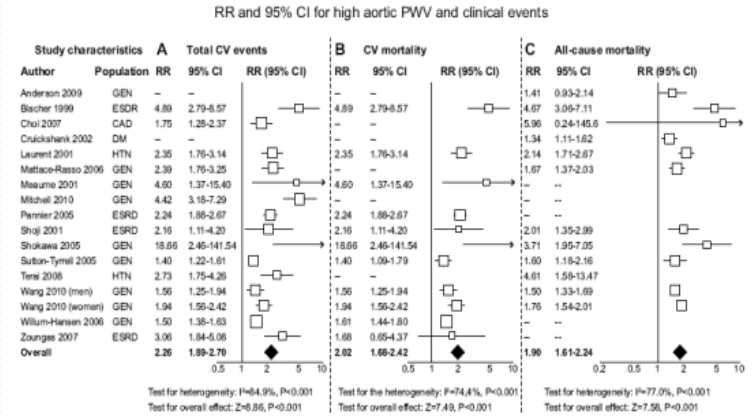
Background

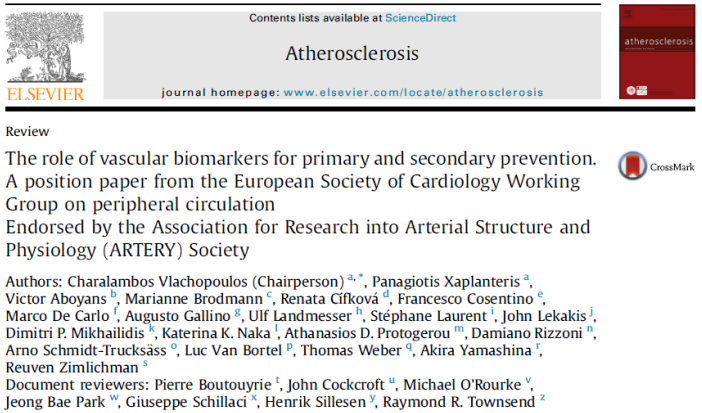
Clinical perspectives

Conclusions

Background

Vascular biomarkers and cardiovascular risk




Contents lists available at ScienceDirect
Atherosclerosis
journal homepage: www.elsevier.com/locate/atherosclerosis
Review

The role of vascular biomarkers for primary and secondary prevention. A position paper from the European Society of Cardiology Working Group on peripheral circulation
Endorsed by the Association for Research into Arterial Structure and Physiology (ARTERY) Society

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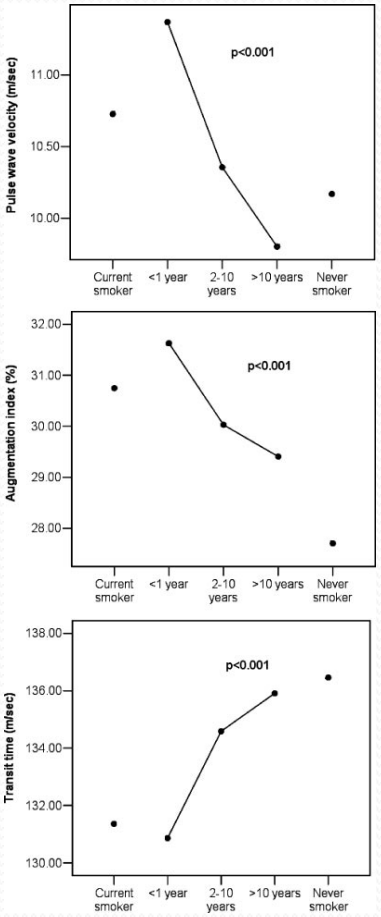
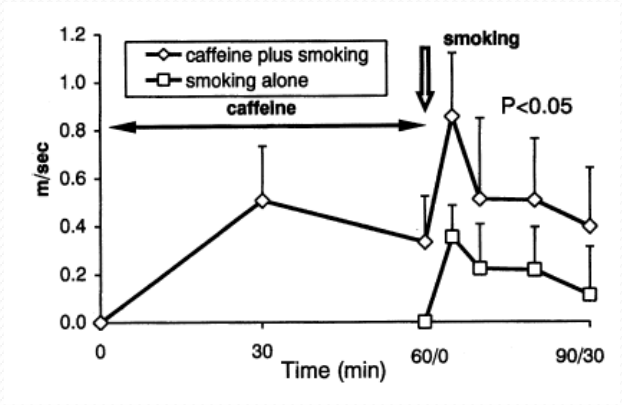
Carotid-femoral pulse wave velocity (aortic stiffness) is a biomarker of vascular function as well as independent predictor of CV risk

Vlachopoulos C et al. J Am Coll Cardiol. 2010
Ben-Shlomo et al. J Am Coll Cardiol. 2014
Vlachopoulos C et al. J Am Coll Cardiol. 2014
Vlachopoulos et al. Atherosclerosis 2015

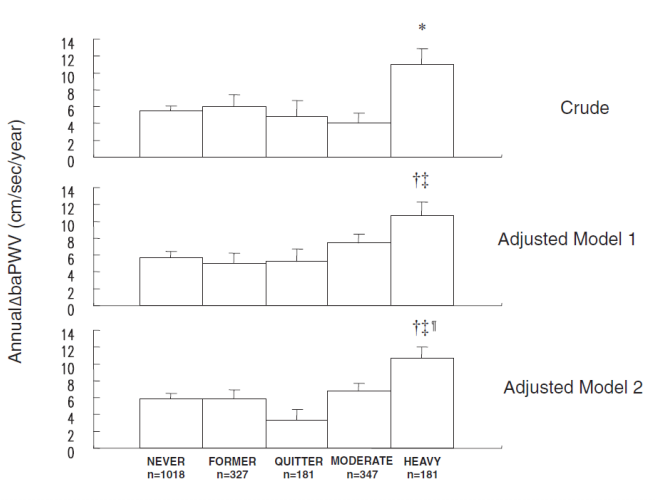
Smoking and vascular stiffness



Jatoi et al., Hypertension 2007



Vlachopoulos et al., JACC 2004



Tomiyama et al., JACC 2010

Smoking has both an acute and chronic detrimental effect on vascular stiffness that can be improved by smoking cessation

The anatomy of electronic cigarette

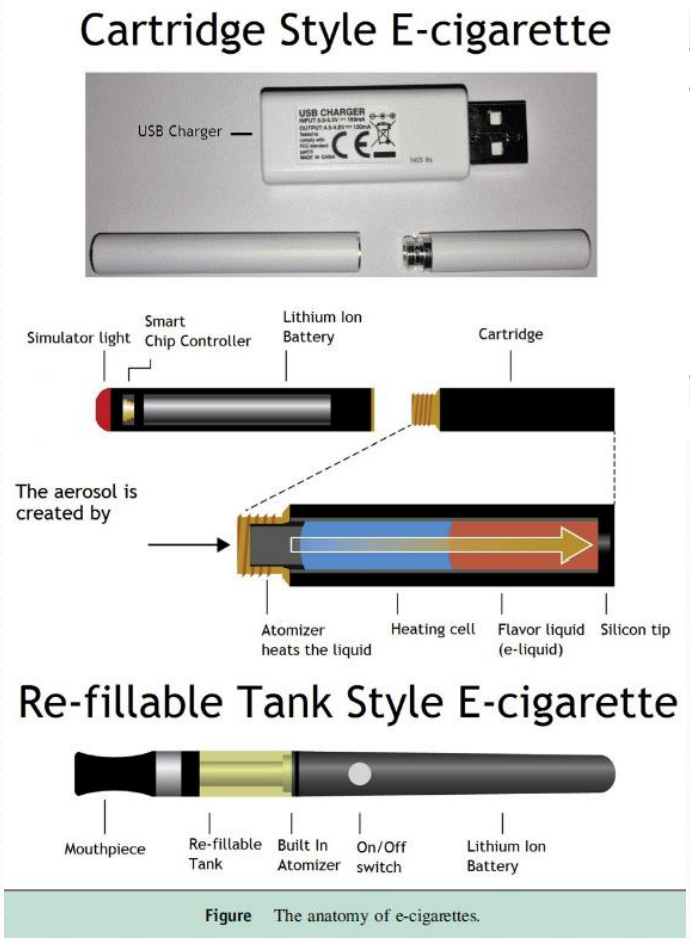


Figure The anatomy of e-cigarettes.

Table 2 Reported Physiologic Effects of E-cigarette Use

Parameter	Effect	Source
Serum carbon monoxide levels	No definite effect with contradicting studies	22,23
Diastolic blood pressure	Significant increase	24
Systolic blood pressure	No significant increase	24
Ventricular systolic and diastolic function	No effect	24
Heart rate	Significant increase after 5 and 10 minutes of use	22,23
Blood counts	No change in WBCs, lymphocytes and granulocytes	25,26
Exhaled nitric oxide (FeNO)	Significant decrease shortly after use	27,28
Respiratory impedances (a marker of peripheral airway flow resistance)	Significant (18%) increase	28
Airway resistance	Significant increase, including nicotine free solutions	29,30

Based on a few studies, e-cigarettes appear to have some immediate adverse health effects, but studies reporting long-term effects on pure e-cigarette users as well as dual users are needed

Orellana-Barios et al., Am J Med 2015

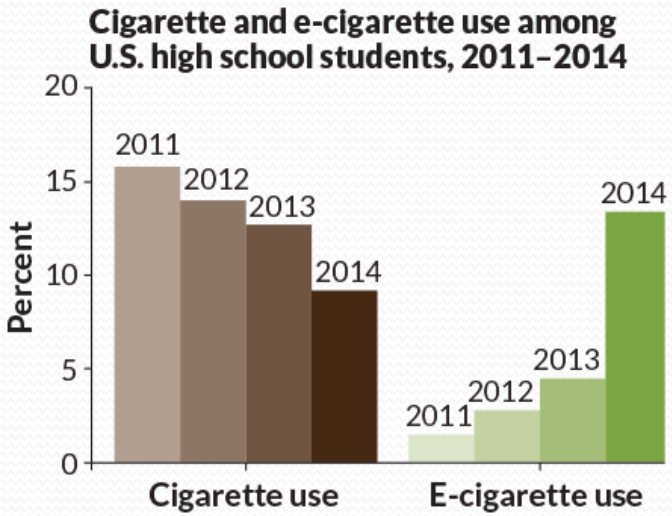
Electronic cigarettes: Are they a Trojan horse?

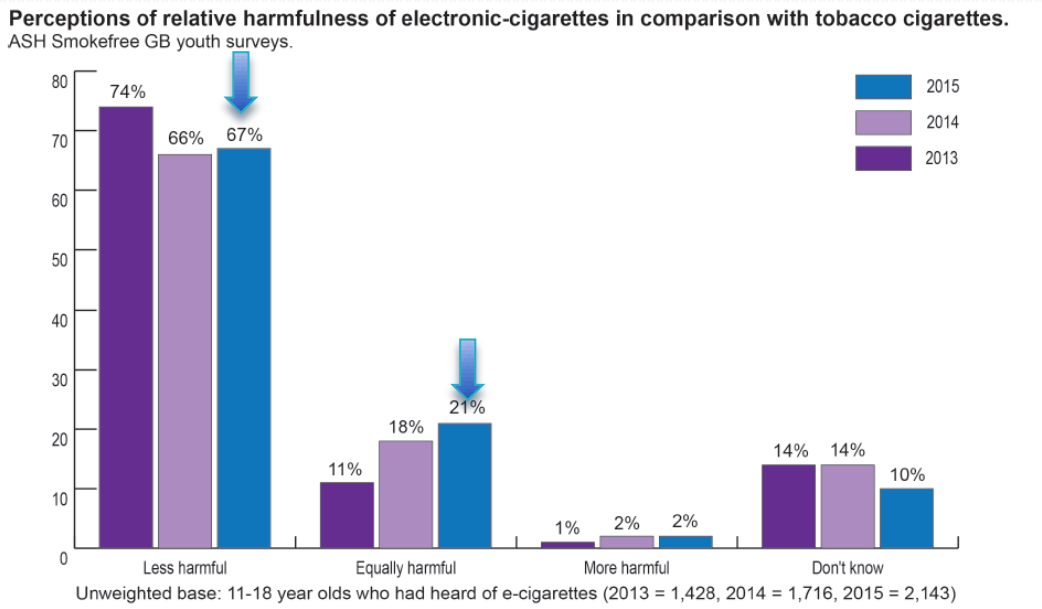
E-cigarettes are popular in adolescents and children

August 2015

ash fact sheet
action on smoking and health

Use of electronic cigarettes among children in Great Britain

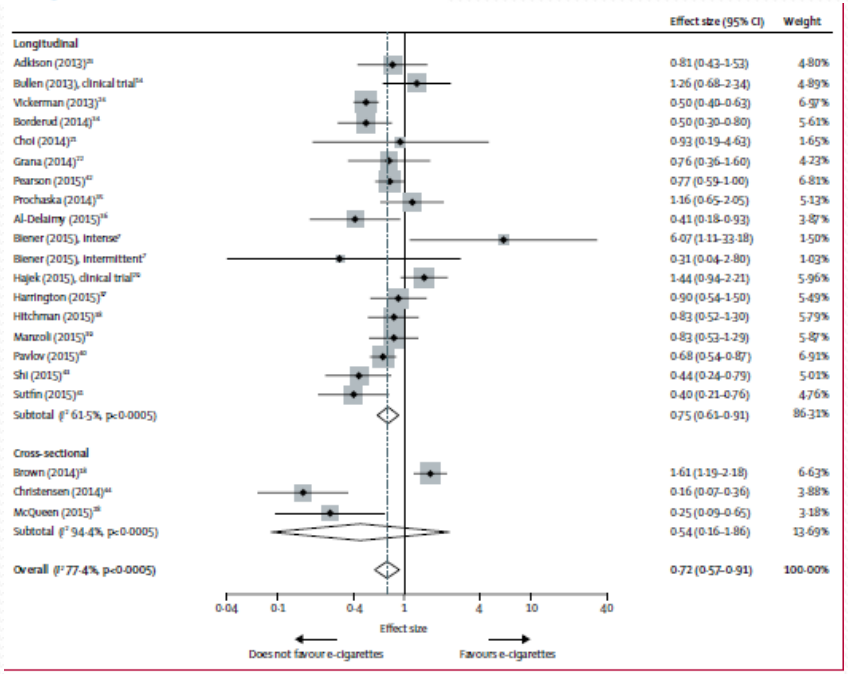




Efficacy

THE LANCET Respiratory Medicine

Compared with smokers who did not use e-cigarettes, the researchers found that those who did were **28%** less likely to quit conventional smoking, even after accounting for other possible confounding factors, such as *previous attempts to quit* and *level of nicotine dependence.*



As currently being used, e-cigarettes are associated with **significantly less quitting** among smokers.

Kalkhoran S, Glantz SA. Lancet Respir Med. 2016

GOV.UK Is it safe?

Press release

E-cigarettes around 95% less harmful than tobacco estimates landmark review

Expert independent review concludes that e-cigarettes have potential to help smokers quit.

Mc Neil et al. Public Health England. 2015

E-cigarettes are **95**% less harmful to users than smoking. **Or**, as we prefer, smoking is estimated to be **twenty times** more harmful to users than vaping e-cigarettes

Nutt et al. Lancet 2016

Safety issues

E-cigarettes: Public Health England's evidence-based confusion

Last week, Public Health England (PHE) reported what it described as a "landmark review" of evidence about e-cigarettes. The headline in their press release quoted "electronic nicotine delivery system products"), and the criteria of harms. The group scored the products for harm, and weightings were applied to the results.

Lancet 2015 (editorial)

E-cigarettes are 'jolly good'
Nigel Farage

Aim of the study

We sought to investigate the acute effect of electronic cigarette (EC) smoking on blood pressure and aortic stiffness, compared to the effects of tobacco cigarette (TC) smoking

Methods

Study population and design

The study was carried out according to a randomized, single-blind, crossover, sham procedure-controlled design.

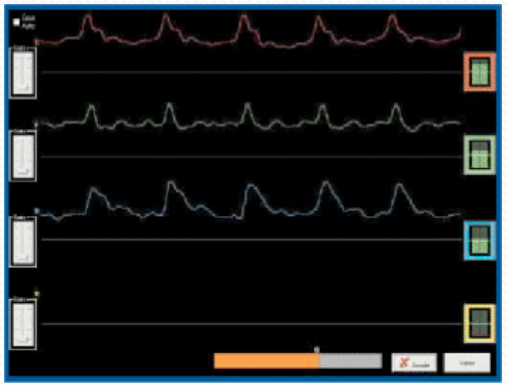
Each participant visited our unit on 4 different occasions (96 sessions in total) and smoked;

a) one standard cigarette (1.1 mg nicotine, 12 mg tar) over 5 minutes,
b) EC (Nobacco, 12 mg/ml nicotine, Tobacco Med, UK) over 5 minutes,
c) EC over 30 minutes and
d) Sham cigarette (by mimicking the pattern of smoking inhalation with an unlit cigarette).

- **EC5min was chosen as a direct comparison with TC (nicotine delivery rate from EC is far lower and slower than with TC), and EC30min to mimic the common pattern of EC smoking (nicotine delivered obtained plasma levels comparable with those after 5 min of TC smoking)**

Measurement of aortic stiffness

- **Carotid-femoral PWV** was calculated with a validated noninvasive device (Complior, Artech Medical).



- Measurements were made before (0 minutes), immediately after the end of TC and short-term EC smoking session (5 minutes), 15, 30 (end of prolonged EC smoking session), 45 and 60 minutes after the initiation of each study session

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Statistical analysis

- The results at various time points were compared with the baseline measurements within each arm, and between the 4 arms using paired and unpaired t-tests, respectively.
- The composite effect of TC or EC versus sham over time was investigated with an analysis of variance for repeated measures.
- Regarding PWV, the composite effect of smoking sessions versus sham over time was investigated by using mean BP as covariate.
- SPSS© 20 was used for the analysis

Results

Results

We studied 24 smokers (age: 30±8 years) otherwise free of CV risk factors

Table. Baseline characteristics of the study population

	Placebo	TC	EC5min	EC30 min	P value
Heart rate	72±7	72±11	74±10	73±10	0.95
Systolic BP	107±12	103±15	108±12	107±13	0.40
Diastolic BP	70±7	68±8	69±7	70±6	0.62
Pulse pressure	37±9	35±10	39±9	37±10	0.35
PWV (m/s)	6.0±1.0	6.0±0.9	6.0±1.0	6.0±1.0	0.82

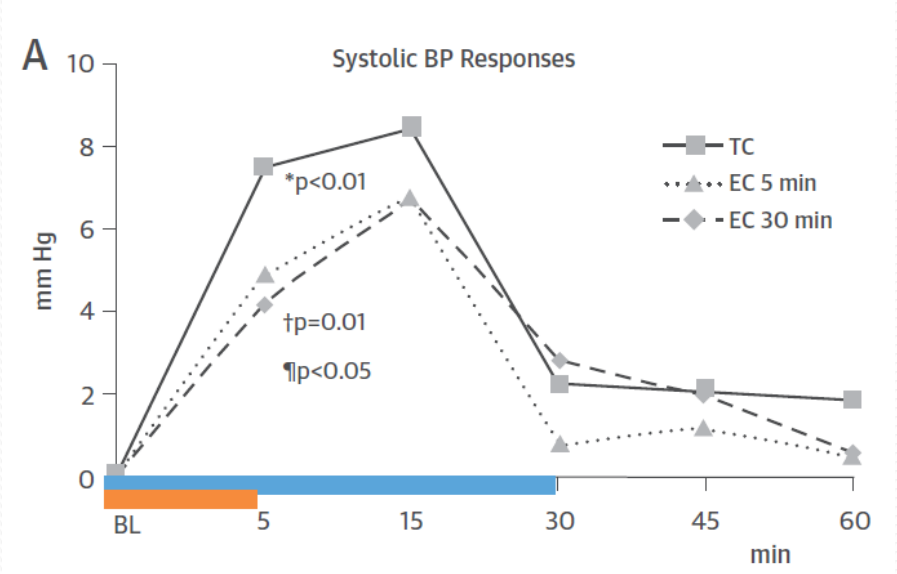
EC: electronic cigarette; BP: blood pressure; PWV: pulse wave velocity; TC: tobacco cigarette

Results

- **Heart rate increased in both the TC and EC 30-min sessions (by 4.0 beats/min after 5 min, $p < 0.05$, and by 3.1 beats/min after 30 min, respectively), whereas the effect of EC5min smoking on heart rate was minimal ($p = 0.57$).**

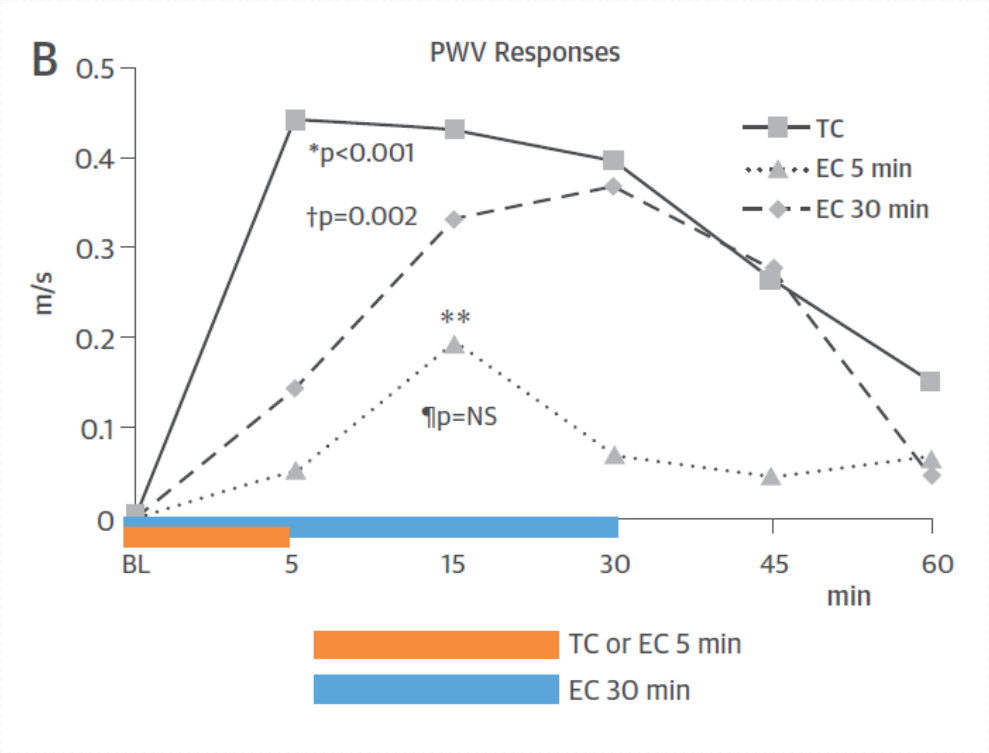
- **Both TC and EC increased systolic BP and the differences in changes of BP responses between the 2 smoking forms were not significant. Diastolic BP exhibited similar patterns of changes.**

FIGURE 1 Systolic BP and PWV Responses



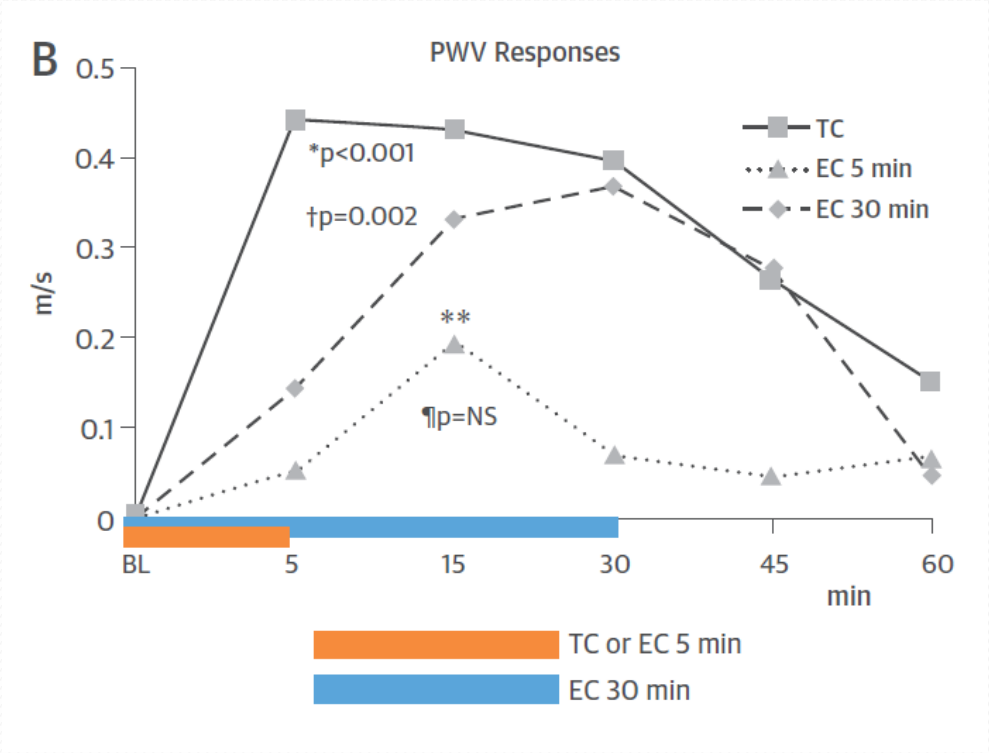
Results

- **PWV increased immediately (by 0.44 m/s) after the end of TC smoking and remained increased throughout the whole period.**
- **EC 5min smoking induced a significant PWV increase after 15 min (by 0.19 m/s).**
- **EC 30min smoking provoked a more potent and prolonged PWV increase (peak immediately after the end of smoking, by 0.36 m/s).**



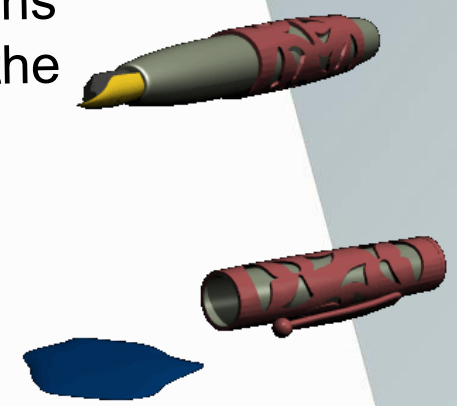
Results

- **Compared with TC, EC5min smoking resulted in a less potent PWV increase throughout the study (F=4.425, p=0.005).**
- **On the other hand, EC30min resulted in a PWV increase similar to that of TC smoking throughout the study period (F=0.268, p=0.615).**
- **EC30min smoking resulted in a more potent effect on PWV compared with EC5min smoking (F=3.167, p=0.030).**



Clinical perspectives

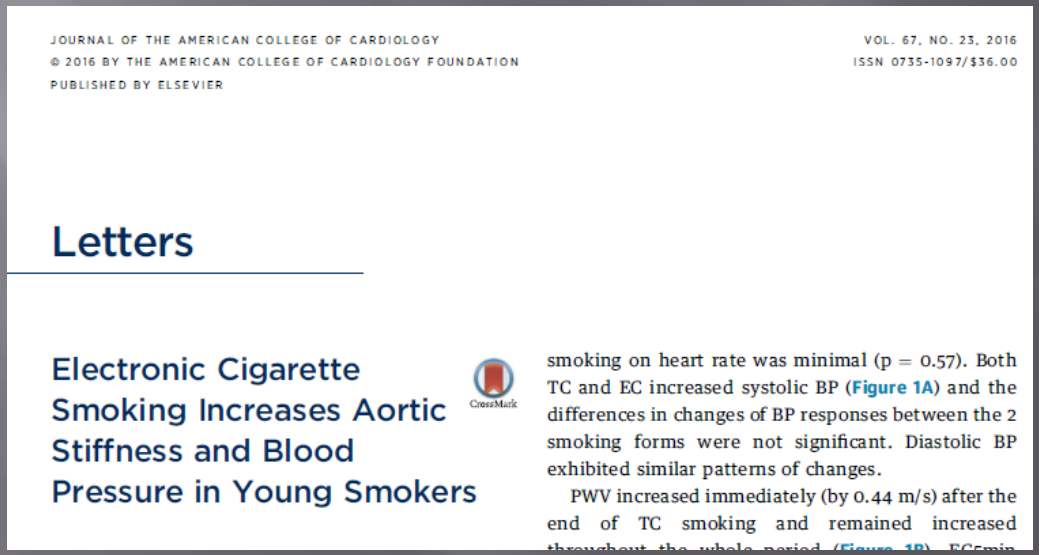
Given the prognostic role of aortic stiffness and increased BP for future cardiovascular events and mortality, as well as the prolonged exposure to EC smoking throughout the day matched with the strong tendency of this form of smoking to spread worldwide, especially within younger ages, our findings have important implications that could aid recommendations regarding the use of EC smoking



Conclusions

Conclusions

- EC smoking increases aortic stiffness.
- In its prolonged form (30 min) the increase is of a magnitude comparable to TC smoking.
- While the precise mechanisms by which EC smoking leads to this altered aortic reactivity remain unclear, there are important health implications given the prognostic role of aortic stiffness.



JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY
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PUBLISHED BY ELSEVIER

VOL. 67, NO. 23, 2016
ISSN 0735-1097/$36.00

Letters

Electronic Cigarette Smoking Increases Aortic Stiffness and Blood Pressure in Young Smokers

smoking on heart rate was minimal ($p = 0.57$). Both TC and EC increased systolic BP (Figure 1A) and the differences in changes of BP responses between the 2 smoking forms were not significant. Diastolic BP exhibited similar patterns of changes.

PWV increased immediately (by 0.44 m/s) after the end of TC smoking and remained increased

Academic research can be only the beginning…

Kristalina Georgieva,
Vice-President of the EC

Abdelrasoul Mahmoud,
Director of the largest
refugee camp in Athens