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Evaluation of the acute effects of chocolate consumption on smoking-induced arterial stiffness; a pilot study

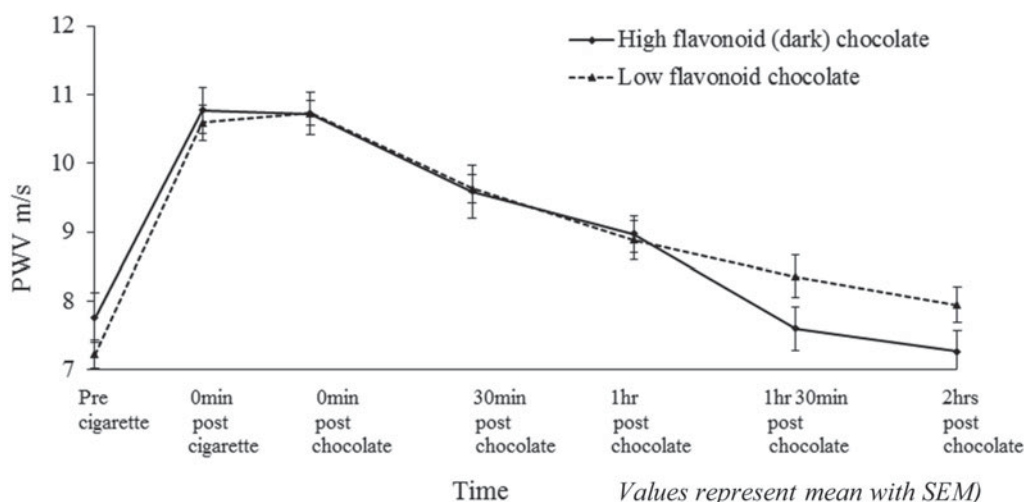
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Cigarette smoking is a major risk factor for cardiovascular disease (CVD) as it increases oxidative stress and reduces the bioavailability of endothelium derived nitric oxide (NO)⁽¹⁾. Research has shown that cocoa flavonoids activate endothelial nitric oxide synthase (eNOS) and enhance endothelium dependent relaxation⁽²⁾. This study evaluated the acute effects of chocolate high in cocoa flavonoids (dark) versus chocolate low in cocoa flavonoids on smoking-induced arterial stiffness.

12 apparently healthy individuals, who were current smokers (3 males, 9 females; mean age 28.9 (SD 8.7) years; BMI 24.5 (SD 3.9) kg/m²) participated in a randomised single-blind crossover trial. Participants were requested to refrain from smoking for at least 2hr and also to fast for at least 2 hr prior to the study commencing. Baseline blood pressure, heart rate and pulse wave velocity (PWV) were measured prior to the intervention. Each participant then smoked a single (regular) cigarette, where upon PWV was measured again before they consumed 50g of high flavonoid (HF) chocolate or 50g of low flavonoid (LF) chocolate. PWV was then repeated and further readings were taken at 30 min intervals up to 2hr post- chocolate consumption. PWV was measured using a sensor based device as described by McLaughlin *et al.*⁽³⁾ Data were analysed using a paired sample t-test.

Smoking a single cigarette increased PWV in the study groups from baseline ($P = 0.46$) There were no significant differences ($P > 0.05$) between the two chocolates with regards to blood pressure, heart rate or PWV. However, at 1 hr post chocolate consumption, the PWV resulting from the HF chocolate consumption dropped (albeit, insignificantly) below that of the LF chocolate (figure), and at 2 hrs post chocolate consumption the PWV resulting from the HF chocolate was lower than baseline values.



Richelle *et al.*⁽⁴⁾ observed that maximum plasma flavonoid concentrations occurred between 2–3 hr post 40 g chocolate consumption, therefore it is feasible that significant differences between the HF and LF chocolates might have been observed if the study had been extended to 3 hr post-chocolate consumption. It is also possible that the 50 g of chocolate in this study may not have been a sufficient amount to achieve significant results since previous research⁽⁵⁾ demonstrated that plasma flavonoids (epicatechin) increased 2.6 fold within the 2 hr following the consumption of 120 g of dark chocolate.

In this pilot study, we used smoking-induced changes in PWV as a model to study the potential of chocolate (high vs. low in cocoa flavonoids) to modulate peripheral arterial stiffness. This model may also be useful for studying other putative dietary modulators of arterial stiffness such as omega-3 or vitamin C.

1. Lavi *et al.* (2008) *J Am Heart Assoc* **41**, 183–187.
2. Karim *et al.* (2000) *J Nutr* **130**, 2105S–2108S.
3. McLaughlin *et al.* (2003) *Physiol Meas* **24**, 693–702.
4. Richelle *et al.* (1999) *Eur J Clin Nutr* **53**(1): 22–26.
5. Engler *et al.* (2004) *J Am Coll Nutr* **23**(3): 197–204.