

Correspondence

Response and acclimatisation of symptomless smokers on changing to a low tar, low nicotine cigarette

SIR,—The paper by Mr G Woodman and others (May 1987;42:336–41) concludes that for low delivery cigarettes "... smokers react to the lack of tar or nicotine, or both, by taking larger puffs while inhaling the same amount of smoke." This warrants further discussion.

Smoke is defined by the authors as that which is labelled by the krypton-81m marker passing into the mainstream smoke through the burning cone.

The first point is that the authors fail to appreciate the importance of paper ventilation. Where cigarette design employs a paper of high porosity—for example, low tar cigarettes—up to 30% of the "smoke" volume entering the filter may have passed through the paper rather than through the burning cone; this is particularly pronounced for the early puffs. The krypton marker will thus reflect paper ventilation in addition to that volume of air passing the burning cone.

Secondly, the inert, gas phase marker krypton will pass totally through any cigarette filter—that is, there will be no deposition in or retention by the filter. This is not the case for either "tar" (particulate matter, water and nicotine free) or nicotine, both of which will be retained to differing degrees by the different filters almost certainly present in the products under study. One would estimate a 10% difference in filtration efficiency, with the middle tar cigarette at 45% and the low tar cigarette at 55% efficiency. Per unit of krypton there would thus be a 10% lower tar and nicotine delivery for the low tar cigarette.

In terms of smoking behaviour a major difference can be inferred from the results presented with respect to the way in which the smoke is handled subsequent to puffing. In the case of the middle tar cigarettes one assumes a zero filter ventilation. Therefore the total puff volume (509 ml) will be labelled with the krypton marker. The "total inhaled smoke volume" is 294 ml and the difference—42% of the total—must thus be attributed to mouthspill or wasted smoke—that is, smoke lost from the mouth between puffing and inhalation. On the other hand, the low tar cigarette will have a ventilated filter, and at the tar level of 3.8 mg this would result in about a 60% dilution of "smoke" with air. The total puff volume (836 ml) will thus comprise 335 ml "smoke" and 501 ml ventilating air. To achieve a "total inhaled smoke volume" of 311 ml there must be negligible mouthspill.

It is therefore clear that: (a) for "smoke" delivery into the mouth there are both quantitative and qualitative (concentration) differences, and these will be even larger than the paper suggests because of the failure of the krypton technique to take into account differences in paper ventilation and filter characteristics between the products; (b) there are large differences in the way in which the "smoke" from the two product types is handled subsequent to puffing and before inhalation.

The authors, quoting unpublished work in the body of their paper, indicate the importance of smoke concentration in defining puff volume and this would appear to be a reasonable conclusion. It is not therefore apparent why the subsequent discussion centres specifically on nicotine and "tar," concluding with the tacit implication that the results of their study support the hypothesis that, when low tar

cigarettes are smoked, a compensation based on the maintenance of a nicotine intake is of fundamental importance. The results if anything detract from nicotine and suggest that factors such as taste, flavour, or trigeminal stimulation may be the more relevant in terms of smoking behaviour.

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* * This letter was sent to the authors, who reply below:

Dr Rawbone is correct in saying that our technique to measure the inhaled smoke volume during cigarette smoking does not take into account the effect of paper porosity, and we are not in a position to dispute Dr Rawbone's data since we do not have access to Gallaher's private research studies. We feel, however, that his case is overstated. He notes that the effect of paper porosity is most pronounced during the early puffs. Hence, even if the contribution of air through porous paper is as much as 30% of that entering the filter at the beginning of the cigarette, the average contribution will be 15% over the cigarette as a whole. In fact it will be less than this since porosity will be reduced as tar, nicotine and water vapour condense on the cool outer paper and change its properties. Inspection of the cigarette filters makes us doubt the conjecture that the middle tar cigarette filter was as much as 10% less efficient than that of the subjects' own cigarettes.

With regard to his statement that the puffing manoeuvre is different with low yield ventilated cigarettes and medium yield unventilated cigarettes, we agree that mouthspill and waste smoke is an important aspect and have already quantified it in unventilated cigarettes.¹ Dr Rawbone will find justification for the "tacit implication" that compensation based on the maintenance of nicotine intake in another of our studies.² We found that when cigarettes of the same tar yield but different nicotine yields were smoked the inhaled smoke volume was increased with the lower nicotine cigarette, presumably to maintain the nicotine intake. Taste is very subjective and has not been investigated by us and although trigeminal stimulation has not been explicitly investigated, the part played by tar in the stimulation of upper airway receptors has already been identified.^{2,3}

The overwhelming implication of our paper remains clear: to reduce the likelihood of contracting a smoking related disease a smoker would be much better advised to stop smoking than to change to a low tar, low nicotine cigarette.

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- 1 Woodman G, Newman SP, Pavia D, Clarke SW. Inhaled smoke volume, puffing indices and carbon monoxide uptake in asymptomatic cigarette smokers. *Clin Sci* 1986;71:421–7.
- 2 Woodman G, Newman SP, Pavia D, Clarke SW. The separate effects of tar and nicotine on the cigarette smoking manoeuvre. *Eur J Respir Dis* 1987;70:316–21.
- 3 Grant SGN, Woodman G, Newman SP, Pavia D, Clarke SW. Sensory mechanisms in the upper respiratory tract affect inhalation of cigarette smoke in man. *Clin Sci* 1986;71:117–9.