**Title:** **Fruit and vegetable consumption and non-communicable disease: Time to update the 5 a day message?**

**Authors: Chris Kypridemos1, Martin O’Flaherty1, Simon Capewell1**

**1*Division of Public Health and Policy, University of Liverpool.***

Correspondence to: Chris Kypridemos, Department of Public Health & Policy, Institute of Psychology, Health & Society. Whelan Building, Quadrangle, L69 3GB, Liverpool UK Tel: 0044 (0)151 795 0130; e-mail: [ckyprid@liverpool.ac.uk](mailto:ckyprid@liverpool.ac.uk)

Studies reporting ‘new’ associations of food ingredients with diseases are common and sensational headlines appear almost daily in the news media. Thus Schoenfeld and Ioannidis [1], in a recent provocative paper, randomly selected fifty common ingredients from a cookbook and reported that forty were apparently associated with increased cancer risk in peer reviewed studies. Unsurprisingly, most of these associations disappeared in subsequent meta- analyses. The result: net increases in media profits, public anxiety and confused politicians. Indeed, the current landscape in nutritional epidemiology research is blighted by an oversaturation of contradictory evidence which risk confusing policy makers, journalists and public about what aspects of the Western diet deserve attention and then intervention. Randomised controlled trails and meta-analyses offer an evidence ‘gold standard’ relatively free of biases. However, trials are simply not feasible, affordable or ethical for many of the most important dietary questions. We therefore fall back on analyses of long term cohorts. At which point considerable cautions then need to be sounded. Thus the populations under study may be highly selected, for instance American doctors or nurses, and the results may not be directly transferable to the general population in Europe or beyond. Above all, we need to apply the very helpful criteria for causal relationships proposed by Bradford Hill, and more recent authors [2,3].

Happily, the study by Oyebode and colleagues [4] convincingly builds on previous evidence to confirm the beneficial effect of fruit and vegetable consumption on England’s population, by linking extensive data from the Health Surveys for England and mortality records. Furthermore, Oyebode and colleagues provide three very interesting and potentially valuable findings that might inform professionals, policy makers and journalists. Firstly, Oyebode and colleagues showed that for this English population, mortality is decreased more by each additional portion of vegetables consumed than each portion of fruit. This provides useful messages for Public Health practitioners and policy makers.

Secondly, a diet rich in vegetables (and fruit) is protective against cancer mortality, cardio-vascular mortality and total mortality. Great benefits are thus potentially achievable in England in future, because at present only 25% of the adult population has already adopted a healthy diet including ‘5 a day’[5]. Therefore, the potential benefits from improving the diet for the remaining 75% of the population are huge. But this could be politically challenging for policy makers. Because the current voluntary agreements with food and beverage companies and televised health education messages are fashionable and inoffensive, but also ineffective. As tobacco and alcohol control successes have so clearly demonstrated, the most powerful interventions are policies which effectively address the ‘3As’ of Affordability, Availability and Acceptability [6].

Thirdly, benefits continue to increase up to at least ‘7 a day’. Indeed, a maximum recommended amount of daily fruit and vegetable consumption cannot easily be defined. The beneficial effect on CVD specific mortality is dose-related, with no obvious threshold up to more than seven portions. Consequently, the UK ‘5 a day’ campaign offers a target which is pragmatic, but one which might provide a false reassurance and risk complacency in the quarter of the population that already hits this target. They need to aim higher.

Furthermore, might refined sugars be acting as the concealed villain in this Shakespearean drama? Consider, gentle reader. A recent study now links sugar consumption to CVD mortality, as an independent risk factor and not only through obesity and diabetes pathways. One can of sugary drink increases heart attack risk by about one third, and risk is increased two-fold in the fifth of the US population with the highest sugar intake [7]. Which emphasises the urgent need for additional analyses to confirm or refute this deeply worrying possibility.

The burning question is thus whether the refined sugars added to ‘processed’ fruit products might reduce, negate or even reverse the fruit potential benefits, and thus explain some of Oyebode and colleagues’ more intriguing results. Because, Oyebode and colleagues found that fresh and dried fruit consumption is reducing the risk of death from all causes, while fruit in composites and fruit juice are less effective and probably not associated with all-cause mortality reduction. This finding clearly supports experts’ recent advice to remove fruit juice from the ‘5 a day’ recommendation [8]. Finally, ‘frozen/canned’ fruit emerged as deleterious in the statistical analysis. Although this finding was not well adjusted for confounding and blends two types of ‘processed’ fruit products, it might also reflect the deleterious effect of sugar that is contained in some of the canned fruit products.

There are thus major implications for official NHS guidance. This currently suggests that dried, tinned or canned fruit, smoothies and up to 150mL of fruit juice all legitimately count towards the ‘5 a day’[9]. While also silently delivering 60g of refined sugars. Yet, under the current recommendations 150ml of freshly squeezed orange juice (sugar 13 g); 30g of dried figs (sugar 14g); 200ml of a smoothie made with fruit and fruit juice (sugar 23g) and 80g of canned fruit salad in fruit juice (sugar 10g) all count as the five portions of the ‘5 a day’; and contain a total of some 60g of sugar. This is more than the sugar in a 500ml bottle of cola, and exceeds even the obsolete World Health Organization recommendation [10].

Is it now time for the UK to update the ‘5 a day’ message to ‘10 a day’?

**References**

1 Schoenfeld JD, Ioannidis JP. Is everything we eat associated with cancer? A systematic cookbook review. *Am J Clin Nutr* 2013;**97**:127–34. doi:10.3945/ajcn.112.047142

2 Hill AB. The Environment and Disease: Association or Causation? *Proc R Soc Med* 1965;**58**:295–300.

3 Rothman KJ, Greenland S. Causation and Causal Inference in Epidemiology. *Am J Public Health* 2005;**95**:144–50. doi:10.2105/AJPH.2004.059204

4 Oyebode O, Gordon-Dseagu V, Walker A, *et al.* Fruit and vegetable consumption and all-cause, cancer and CVD mortality: analysis of Health Survey for England data. *J Epidemiol Community Health*;:2014.

5 Health and Social Care Information Centre, 1 Trevelyan Square. Health Survey for England - 2011, Trend tables. 2012.http://www.hscic.gov.uk/catalogue/PUB09302 (accessed 17 Feb2014).

6 Gornall J. Doctors and the alcohol industry: an unhealthy mix? *BMJ* 2013;**346**:1889–1889. doi:10.1136/bmj.f1889

7 Yang Q, Zhang Z, Gregg EW, *et al.* Added sugar intake and cardiovascular diseases mortality among us adults. *JAMA Intern Med* Published Online First: 2014. doi:doi:10.1001/jamainternmed.2013.13563

8 Gill JM, Sattar N. Fruit juice: just another sugary drink? *Lancet Diabetes Endocrinol* Published Online First: February 2014. doi:10.1016/S2213-8587(14)70013-0

9 NHS Choices. 5 A DAY: what counts? - Live Well. 2014.http://www.nhs.uk/Livewell/5ADAY/Pages/Whatcounts.aspx (accessed 17 Feb2014).

10 Nishida C, Uauy R, Kumanyika S, *et al.* The Joint WHO/FAO Expert Consultation on diet, nutrition and the prevention of chronic diseases: process, product and policy implications. *Public Health Nutr* 2007;**7**:245–50. doi:10.1079/PHN2003592