

UNIVERSITY OF SURREY - WRITTEN EVIDENCE (FDO0082)

Authors: Dr Adam Collins (*Associate Professor in Nutrition Science*) & Professor Susan Lanham-New (*Head, Department of Nutrition, Food & Exercise Sciences*), University of Surrey.

Written evidence summary

The University of Surrey response provides answers to questions one, two and three of the House of Lords Committee on Food, Diet and Obesity call for written evidence. The University of Surrey's work in this area has been specifically recognised through our successful submission to the Queen's Anniversary Prize (QAP) for *Food & Nutrition for Health*, which was awarded in 2017/2018: "*Fifty years of distinguished research and teaching in food and nutrition – benefiting public health and educating future practitioners*".

Reducing the risk of obesity, diabetes and cardiovascular disease through research on energy, macronutrients and micronutrients (vitamin D)

1. Driving fundamental research on dietary saturated fats and cholesterol, the University of Surrey's research on the effects of dietary fats and cholesterol on CVD risk has helped to shape nutritional policy in the UK. This work has increased understanding of how dietary fats affect cardiovascular health, and has been formative in establishing dietary guidelines for the optimal intake of polyunsaturated fats, and in reinforcing existing recommendations to restrict intake of saturated fat in the UK population. The work has been supported by income from the Food Standards Agency (FSA), the Biotechnology and Biological Research Council (BBSRC) and the food industry.
 2. The University's research formed an integral part of BBSRC's Strategic Framework priorities from (2015 to 2020 and 2021 to current), and this has cited two of the University's projects as model examples of the transformative power of nutritional research (Dietary Fat and Vitamin D). Funded by BBSRC, the University is conducting a unique intervention study on the effect of dietary sugar in men with non-alcoholic fatty-liver disease (NAFLD), which now affects 80% of people with obesity and can lead to cirrhosis. This timely study has identified mechanisms by which sugar promotes NAFLD, and will add significant support to new government policy by Public Health England (PHE) to reduce our intake of sugar by 50 per cent.
 3. *Poor vitamin D health is associated with obesity:* The University of Surrey's work on vitamin D has found clear evidence of poor vitamin D status amongst population groups who are overweight and obese. This has been consistently shown in our Food
-

Standard's Agency (FSA) project (D-FINES), in our Biotechnology and Biological Sciences Research Council (BBSRC) D2-D3 study and in our EU funded Vitamin D Project (ODIN). This is particularly the case in population groups with increased central adiposity (high waist-to-hip ratio). In addition, Surrey's vitamin D has extensively examined vitamin D deficiency prevalence in ethnic groups (South Asian groups; pre- and postmenopausal women) from our FSA: DFINES study, BBSRC:D2-D3 study and from the UK Biobank dataset (over 8000 South Asian's included in the analysis) and found: 1) vitamin D deficiency/insufficiency in 80-90% of the South Asians; 2) the effect of overweight and obesity compounds the vitamin D deficiency issue. Our new research suggest that there are similar trends in other ethnic groups such as British black African-Caribbean populations.

4. *Preventing diabetes with resistant starch:* The University's Resistant Starch (RS) research has been key in identifying the role of RS in type-2 diabetes prevention. Diabetes and obesity are intricately linked. While dietary fibre is known to reduce the incidence of cardiometabolic disease (a heart disease associated with diabetes), studies by others had linked it with a reduction in type-2 diabetes risk but had failed to explain the underlying mechanisms. This research has broken important new ground by establishing that colonic fermentation of RS improves tissue insulin sensitivity. This work provided key evidence for a health claim in approved by the FDA (Food and Drug Administration) for the food labelling of type-2 RS in diabetes prevention.

Obesity reduction (1) - correcting inaccurate dietary guidelines for egg consumption by investing in evidence-based research

1. Reducing the prevalence of cardiovascular disease (CVD) is a major aim of all healthcare systems worldwide as it has a significant negative impact on both population health and wellbeing, and the economy of all developed countries. For example, within the UK, the British Heart Foundation report that the cost to the UK economy (including premature death and disability) of CVD is estimated to be over £15 billion each year. Furthermore, CVD causes more than a quarter (26 per cent) of all deaths in the UK with one death occurring every three minutes. Obesity is a key risk factor for CVD and, as noted earlier, the implications of being overweight or obese to public health and the economy are grave.
-

2. Based upon the incorrect assumption that dietary cholesterol intake was directly linked to plasma cholesterol levels, UK policy was endorsed to reduce the public consumption of cholesterol rich foods, such as prawn and eggs and included advice to restrict the number of eggs consumed to no more than three per week¹.
3. Research by the University of Surrey demonstrated that this assumption was false, leading to a significant policy impact and a transformational change in advice, human consumption and future health outcomes. Our review of over 30 years of prospective cohort studies, followed by our studies showing the direct demonstration of a lack of association between dietary cholesterol and plasma low density lipoprotein, formed an important part of the compelling evidence that underpinned the revision of European dietary guidelines to remove the previous restriction on egg consumption². This policy impact was endorsed by such bodies as the British Heart Foundation³, HEART UK, and the British Dietetics Association⁴.
4. In addition to the impact of our work in the UK, the findings of our research have had a much wider reach, altering consumption advice in countries such as the USA⁵ and Australia⁶. The revisions to European dietary guidelines led to successful campaign during early 2009 by stakeholders⁷ and the media⁸ resulting in a significant

¹ Joint WHO/FAO/UNU Expert Consultation Protein and amino acid requirements in Human Nutrition, WHO Technical Report Series 935, Geneva, 2002. FSA (Food Standards Agency) (2002) McCance and Widdowson's The Composition of Foods, 7th Edition, Cambridge: RSC

² UK and European advice on food-based dietary guidelines.
<http://www.nhs.uk/Livewell/Goodfood/Pages/eggs-nutrition.aspx>
<http://www.efsa.europa.eu/en/search/doc/1460.pdf> (2010)

³ British Heart Foundation – comment on the lack of association between eggs and LDL cholesterol (2011) <http://www.bhf.org.uk/default.aspx?page=12920>

⁴ British Dietetics Association – Cholesterol Factsheet (2010)
<http://www.bda.uk.com/foodfacts/cholesterol.pdf>

⁵ US Department of Agriculture Dietary Guidelines (2010)
<http://www.health.gov/dietaryguidelines/dga2010/DietaryGuidelines2010.pdf>. American Egg Board – realities and misconceptions. <http://www.aeb.org/food-manufacturers/all-about-egg-products/realities-misconceptions>

⁶ Food Standards Agency Australia-New Zealand (2013).
http://www.foodstandards.gov.au/publications/Documents/FINAL_Guidance-generallevel-health-claims-Sept_2013.docx. Australian Egg Industry – Health and Nutrition (2011).
<http://www.eggs.org.au/health-and-nutrition>.

⁷ Industry coverage on dietary cholesterol and cardiovascular risk.
http://www.britegg.co.uk/files/user_files/contact/liftingthelimits.pdf
<http://www.thepoultrysite.com/poultrynews/17099/lifting-the-limits-on-egg-intake> (2009)

societal impact through the better understanding of the relationship between dietary cholesterol and CVD. This impact can be demonstrated through a substantial shift in public perception of the risk and benefit associated with eggs: in three independent surveys of the general public conducted in 2008 (1,000 people), 2012 (1,574 people) and 2015 (1,636 people), the percentage of people who believed egg intake should be limited to no more 3 eggs per week fell consistently from 45% to 28% to 26%, respectively. In contrast, the number of people who believed that it was safe to consume more than 6 eggs per week, more than doubled over the same period (19%, 37%, 42%, respectively).

5. As well as the social benefits from more accurate dietary advice, this shift in public perception of the risk and benefit associated with eggs has also had an important economic impact. Consumer purchasing data indicates that egg sales in the UK were stagnant in 2008, increasing by only 0.5% in that year. However, following the alteration in government advice and public engagement activities resulting from this work, egg sales have grown year-on-year, with volume sales growth increasing by 22% between 2008-2016⁹. While there are numerous physical and demographic variables that may contribute to changes in the perception of risk and to increased egg sales, the British Egg Industry has identified the misconception of the relationship between dietary cholesterol in eggs and increased CVD as being the most important barrier to egg consumption in the UK over the last decade. Given that in 2011 approximately 11.5 million eggs were sold in the UK, generating revenue of over £885 million, it is possible to estimate the economic impact of this research; an increase in sales of 6.1% approximates to an additional £54 million to the UK economy.
 6. In summary, our research has been crucial in dispelling the long-standing belief that there was an association between dietary cholesterol, plasma low density lipoprotein levels, and hence cardiovascular disease. Our work has had a significant impact on the dietary guidelines issued by both national and international
-

⁸ Media Coverage on dietary cholesterol and cardiovascular risk. <http://www.telegraph.co.uk/health/healthnews/4581618/You-can-now-go-to-work-on-anegg-every-day-scientists-say.html> (2009). <http://www.dailymail.co.uk/health/article-1140668/Eggs-menu-Theyre-heart-attackersfact-help-diet-say-experts.html> (2009). <http://www.thesun.co.uk/sol/homepage/woman/health/health/article2223903.ece> (2009)

⁹ Positive impact on egg sale. Egg sale figures derived from Kantar Worldpanel market monitoring data (2009-2013)

bodies, as well as the advice from leading healthcare associations. In addition, through a significant shift in the public perception of the health risks/benefits of egg consumption there has been an increase in egg sales, resulting in a significant positive economic impact to the egg industry, UK and overseas and people's nutrition.

Obesity reduction (2) - Improving food nutrient labelling by investing in sustainable research

7. Our research on food labelling over the last five years has been transformational in helping the UK address these stark issues and has achieved widespread recognition. In terms of wider social benefit, we led the development of the scientific rationale and design for the study, funded by the Food Standards Agency (FSA), which successfully extended the evidence base for UK nutrition signpost labelling schemes¹⁰. From a policy perspective, these research outcomes were instrumental in ensuring the four devolved administrations of the UK government collaborated, resulting in a joint food labelling consultation, a process necessary for ensuring buy-in from a wide range of stakeholders who had previously strongly resisted a standardised approach. Our further research on consumer understanding of front-of-pack nutrition labels¹¹ directly informed the questions posed within that important consultation process.
8. In October 2012, based on the results of the consultation, the Department of Health (DoH) announced the introduction of a new, standardised front-of-pack labelling format based on a hybrid of Traffic Lights and percentage Guideline Daily Amounts. By June 2013 all the main UK retailers and many food manufacturers had signed up to the new labelling scheme, accounting for over 60% of the food sold in the UK. Following this agreement, technical guidance for implementation of the new hybrid label by industry was issued by the DoH¹² and this acknowledges the important

¹⁰BMRB Social Research & University of Surrey (2008) Comprehension and use of UK nutrition signpost labelling schemes: Scientific Rationale and Design. London: Food Standards Agency. Available at: <http://webarchive.nationalarchives.gov.uk/20120206100416/http://food.gov.uk/multimedia/pdfs/quantrationale.pdf>

¹¹ Hodgkins, C et al., (2012). Understanding how consumers categorise nutritional labels; a consumer derived typology for front-of-pack nutrition labelling. *Appetite* 59, 806–817.

¹² Guide to creating a front of pack (FoP) nutrition label for pre-packed products sold through retail outlets (updated Nov 2016). Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/566251/

University of Surrey contribution¹³. In June 2013¹⁴, the UK Health Minister stated that “*Research shows that, of all the current schemes, people like this label the most and they can use the information to make healthier choices*”. This was supported by British Heart Foundation whose Chief Executive said, “*This is undeniably a first-class scheme that will make it easier for shoppers to scan the shelves and make more informed choices about what’s going in their trolley ... it’s essential we have clear and consistent food labelling so people can make healthy choices.*”

Development of a simplified mathematical model to predict expectant weight loss in response to a known energy deficit.

9. The long-established treatment for those overweight and with obesity is to achieve weight loss (typically $\geq 5\%$ of starting weight). Despite a huge variety in weight loss approaches this is fundamentally achieved via an energy (calorie) deficit. Moreover, individual weight loss goals are centred around a projected weight loss for a given energy deficit within clinical practice. Such assumptions are often used to assign the most suitable intervention type and/or length of intervention. In addition, this is commonly used to assess patient progress and compliance with the intervention.
10. Weight loss results in obligatory reductions in energy expenditure (EE) due to loss of metabolically active fat-free mass (FFM). This is often accompanied by adaptive reductions designed to restore energy balance whilst in an energy crisis. Such declines are suggested to be amplified during rapid weight loss. The so-called “3500-kcal rule” is used to advise weight loss in clinical practice¹⁵, commonly equating to a 500-kcal/day deficit leading to approximately 1kg of weight loss per week. However, the assumption that energy expenditure remains constant during energy restriction significantly overestimates expectant weight-loss.

[FoP_Nutrition_labelling_UK_guidance.pdf](#)

¹³ Storcksdieck, S., et al.,(2010). Penetration of nutrition information on food labels across the EU-27 plus Turkey. *European Journal of Clinical Nutrition* 64, 1379-1385.

¹⁴ Government press Release: “Final design of consistent nutrition labelling scheme given green light” (June 2013). Available at: <https://www.gov.uk/government/news/final-design-of-consistent-nutritional-labelling-system-given-green-light>

¹⁵ Egan AM, Collins AL. Dynamic changes in energy expenditure in response to underfeeding: a review. *Proc Nutr Soc.* 2022 May;81(2):199-212. doi: 10.1017/S0029665121003669

11. At Surrey, a mathematical model of weight loss was developed using ordinary differential equations relying on simple inputs of weight and energy intake to predict weight loss over a specified time. The proposed model was tested and refined using: (i) retrospective data from a commercial weight management company (ii) secondary data from a randomised controlled trial and (iii) prospective data from a nutrition intervention trial where reductions in obligatory and adaptive resting energy expenditure were quantified during a total-diet replacement programme (TDR; 600–810 kcal/day).
12. This work culminated in a novel weight-loss prediction method to accurately account for EE's dynamic trajectory. Subsequently, Mathematical modelling predicted post-intervention weight-loss within 0.80% of that observed in overweight and obese females. These results highlight the metabolic processes determining short-term weight-loss and provide evidence for an immediate adaptive response to energy deficit. The proposed mathematical model simulates weight loss with reasonable accuracy whilst only requiring simple inputs of starting weight and energy (calorie) intake, supporting the potential application in clinical weight management. We plan to define and develop this model further within nutrition intervention studies. We also envisage this model being a valuable tool beyond just the planning of weight loss interventions, but importantly, aiding weight maintenance and the prevention of weight regain.

Exploring ways of improving metabolic health independent of weight loss – with applicability to weight maintenance.

13. Having excess body weight correlates significantly with a rise in comorbidities, such as cardiovascular disease (CVD), cancer, and type 2 diabetes mellitus (T2DM), as corroborated by numerous epidemiological studies and imposes considerable demands on healthcare systems. From a metabolic perspective, it is documented that a 5%-10% weight loss in those overweight or with obesity can enhance glycaemic and lipid profiles. Yet, paradoxically, elevated cardio-metabolic risk can also manifest in individuals of normal weight, whilst some with higher body weight may maintain metabolic health.
 14. Continuous Energy Restriction (CER) has traditionally been the primary means of tackling excess body weight issues, but more recently, Intermittent Energy Restriction (IER) has emerged as an
-

effective alternative dietary intervention, not just for weight loss. Both CER and IER diets facilitate comparable weight loss, the unique attributes of IER may exert additional metabolic benefits¹⁶. At Surrey, we were one of the first to demonstrate that even with matched weight loss, IER may confer superior benefits on postprandial lipaemia compared to CER diets¹⁷.

15. Such benefits are attributable to the repeated metabolic shifts from glucose to fatty acid and ketone utilization induced by IER regimens, akin to improved “metabolic flexibility”. An enhanced capacity to efficiently switch between fat oxidation and other metabolic processes depending on fuel availability and metabolic demand could be a key factor underlying the benefits of IER. To this end, here at Surrey, we continue to explore how these demonstrated effects of IER can be achieved through novel dietary interventions independently of weight loss.
16. From our mechanistic acute studies, we have observed that the varying levels of carbohydrate availability may explain the dose-responsive metabolic effect. This has questioned the extent to which these responses might be attributed solely to variations in carbohydrate intake. From this, we have investigated the acute metabolic effects of carbohydrate restriction at varying energy levels to isolate and examine the specific metabolic responses exclusively linked to carbohydrate reduction. This work aims to develop a novel intermittent carbohydrate restriction intervention that can have long-term effectiveness for weight management.
17. In other studies, at Surrey, we are also examining the metabolic effects of another form of IER, namely, time-restricted eating (TRE), where an extended “fasting” period is introduced every 24 hours, though the shortening of the eating window. One concern of this approach is the propensity to overeat within eating windows, but also ensuring that there is sufficient nutritional intake within such a restricted regime. To this end, we are examining the potential for the allowance of a protein supplement to be consumed outside of

¹⁶ Antoni R, Johnston KL, Collins AL, Robertson MD. Effects of intermittent fasting on glucose and lipid metabolism. *Proc Nutr Soc.* 2017 Aug;76(3):361-368. doi: 10.1017/S0029665116002986.

¹⁷ Antoni R, Johnston KL, Collins AL, Robertson MD. Intermittent v. continuous energy restriction: differential effects on postprandial glucose and lipid metabolism following matched weight loss in overweight/obese participants. *Br J Nutr.* 2018 Mar;119(5):507-516. doi: 10.1017/S0007114517003890. PMID: 29508693.

the window to improve compliance and overall intake without blunting the metabolic effects of the fast.

18. All of these studies aim to provide alternative dietary interventions that can be applied to currently underserved population groups. Namely a) those of normal weight but at elevated metabolic risk (dyslipidaemia, impaired glucose tolerance or "prediabetes), and b) those transitioning off of more traditional weight loss interventions, including pharmaceutical interventions such as GLP-1/GIP agonists, who are looking to maintain weight and prevent weight regain.

8 April 2024
