Institution: University of Surrey

Unit of Assessment: UOA 3 Allied Health Professions, Dentistry, Nursing and Pharmacy

Title of case study:

Improving population health and wellbeing through changing public perception of the link between dietary cholesterol and cardiovascular disease risk

1. Summary of the impact (indicative maximum 100 words)

Cardiovascular disease is the largest killer in the developed world, with 50% of people affected during their lifetime. While the link between raised plasma cholesterol and cardiovascular disease is well established, heart-health policy to limit dietary cholesterol intake was based on the unsupported belief that dietary cholesterol was a key determinant of plasma cholesterol.

Researchers at Surrey were central to demonstrating no direct correlation between cholesterol-rich food and plasma cholesterol. This research led to multiple impacts: alteration of national and international dietary guidelines; better public perception of cholesterol control; and commercial impact through the increased consumption of cholesterol-containing foods.

2. Underpinning research (indicative maximum 500 words)

Cardiovascular disease is a major cause of increased morbidity and mortality in the UK. In 2009, approximately one-third of all deaths in the UK were attributed to cardiovascular disease. This major health burden translates to an estimated cost to the UK economy of approximately £30billion per annum, equivalent to one-third of the total NHS budget for 2011/12. As such, there has been major investment in the development of guidelines, both national and international, aimed at reducing the risk of cardiovascular disease.

There is an incontrovertible relationship between a raised concentration of blood cholesterol, particularly in the form of low density lipoproteins (LDL), and development of cardiovascular disease (CVD). While the association between raised blood cholesterol and CVD is well established, the utility of blood cholesterol as a biomarker for dietary cholesterol is much more controversial. Griffin (Professor of Nutritional Metabolism) was part of PASSCLAIM (Process for the assessment of scientific support for claims on foods), a European Union project funded under Framework 5 (2001-2003). One purpose of PASSCLAIM was to establish common criteria for how biomarkers of disease risk should be used in exploring links between diet and health. Griffin's critical contribution to this project was to reaffirm the value of raised blood cholesterol as a marker of CVD risk that could be used to evaluate the impact of dietary components, such as dietary cholesterol, on CVD risk (**1**).

Underpinning health policy aimed at reducing circulating cholesterol was the belief that there was a direct relationship between dietary and blood cholesterol; as such, strict limits on the consumption of cholesterol-rich foodstuffs were imposed. However, prior to the work carried out at Surrey, the relationship between dietary and blood cholesterol was without proper scientific validation or clinical consensus.

In 2005, the British Egg Industry Council funded further work at the University of Surrey to examine the relationship between dietary and plasma cholesterol concentrations. The outcomes of this study proved conclusively the lack of association between egg-derived dietary cholesterol and plasma LDL and were published by Griffin in 2008 (**2,3**). Following on from the demonstration that cholesterol derived from egg-intake did not significantly impact upon blood cholesterol levels, this

work has been expanded by the Surrey team to include other cholesterol-rich foodstuffs. More recent work co-funded by the European Fisheries Fund and the Sea Fish Industry Authority has demonstrated that there is no relationship between the dietary intake of cold-water prawns and plasma LDL cholesterol levels (**4**).

Taken together, the findings of the Surrey team (led by Griffin) have established that the lack of association between dietary and plasma cholesterol may represent a general paradigm rather than a specific finding for a single foodstuff.

3. References to the research (indicative maximum of six references)

1. Mensink, R.P., Aro, A. denHond, E., German, J.B., **Griffin, B.A.,** ter Meer, H.U., Mutanen, M., Pannemans, D. and Stahl, W. PASSCLAIM – Diet-related cardiovascular disease European Journal of Nutrition (2003) **42:** 6-27. DOI: 10.1007/s00394-003-1102-2
2. Harman NL, Leeds AR & Griffin BA. Increased dietary cholesterol does not increase plasma low density lipoprotein when accompanied by an energy-restricted diet and weight loss. European Journal of Nutrition (2008) **47**:287-293. DOI: 10.1007/s00394-008-0730-y
3. Gray J & Griffin BA. Eggs and dietary cholesterol - dispelling the myth. British Nutrition Foundation Nutrition Bulletin (2009) **34**, 66-70. DOI: 10.1111/j.1467-3010.2008.01735.x
4. Isherwood, C., Wong, M. Jones, W.S., Davies, I.G. and Griffin, B.A. Lack of effect of cold water prawns on plasma cholesterol and lipoproteins in normo-lipidaemic men. Cellular and Molecular Biology (2010) **56:** 52-58. DOI: 10.1170/T879

4. Details of the impact (indicative maximum 750 words)

Reduction in the prevalence of CVD is a major aim of all healthcare systems worldwide. Cardiovascular disease has a significant negative impact on both population health and wellbeing, and the economy of all developed countries. Based upon the false assumption that dietary cholesterol intake was directly linked to plasma cholesterol levels, policy was enacted to reduce the public consumption of cholesterol rich foods, such as eggs and prawns. Previous dietary guidelines for the prevention of CVD included advice to restrict the number of eggs consumed to no more than three per week (**Ref 1**).

The work conducted at Surrey demonstrated that this assumption is false, leading to a significant policy impact. The initial systematic review of over 30 years of prospective cohort studies, followed by the direct demonstration of a lack of association between dietary cholesterol and plasma LDL formed an important part of the weight of evidence underpinning the revision of European dietary guidelines to remove the previous restriction on egg consumption (**Ref 2**).

This policy impact was endorsed by such bodies as the British Heart Foundation (**Ref 3**), HEART UK, and the British Dietetics Association (**Ref 4**). In addition to the impact of this work in the UK, the findings of the Surrey research team have had a much wider reach, altering consumption advice in countries such as the USA (**Ref 5**) and Australia (**Ref 6**).

The revisions to guidance detailed above led to a widespread media campaign during early 2009, from both stakeholders (**Ref 7**) and the popular press (**Ref 8**), resulting in a significant societal impact through the better understanding of the relationship between dietary cholesterol and CVD. This impact can be demonstrated through a large shift in public perception of the risk and benefit associated with eggs: In a survey of 1,000 members of the general public conducted in 2008, only 19% believed that it was safe to consume more than 6 eggs a week, whereas in a repeat survey in 2011, this figure had increased to 36% (**Ref 9**).

The shift in public perception of the risk and benefit associated with eggs, has also resulted in 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, increasing by 6.1% during the period 2009-2011 (**Ref 10**).

Whilst 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 into the UK economy.

In summary, the work of the Surrey research team was crucial in dispelling the long-standing belief that there was an association between dietary cholesterol, plasma LDL levels, and hence cardiovascular disease. Their work has had a significant impact on the dietary guidelines issued by both national and international 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 economic impact to the industry.

5. Sources to corroborate the impact (indicative maximum of 10 references)

Ref 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, Sixth summary edition. Cambridge: Royal Society of Chemistry

Ref 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)

Ref 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

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

Ref 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

Ref 6. Food Standards Agency Australia-New Zealand (2013)
http://www.foodstandards.gov.au/publications/Documents/FINAL Guidance-general-level-health-claims-Sept 2013.docx
Australian Egg Industry – Health and Nutrition (2011)
http://www.eggs.org.au/health-and-nutrition

Ref 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)

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

Ref 9. Change in public perception on the health risks of egg consumption
Collated data from 5 surveys undertaken by TNS Omnimas (2008-2011)

Ref 10. Positive impact on egg sales
Egg sale figures derived from Kantar Worldpanel market monitoring data (2009-2011)