Food and Behaviour Research warmly welcomes you to the

Medical Sciences Teaching Centre, University of Oxford

SUGAR AND THE BRAIN: FOOD CHOICE, ADDICTION AND THE MENTAL HEALTH CRISIS

A SYMPOSIUM WITH PROFESSOR ROBERT LUSTIG MD

Wednesday, 13th March 2013

12.30pm – 1.00pm	**Registration**
1.00pm – 1.10pm	**Chairman's Introduction** ***Professor Sarah Stewart-Brown*** *(Professor of Public Health, Statistics and Epidemiology, Division of Health Sciences, Warwick Medical School, University of Warwick)*
1.10pm – 1.25pm	**'Pure, White and Deadly' – A legacy remembered** ***Professor Michael Yudkin*** *(Professor Emeritus of Biochemistry, University of Oxford)*
1.25pm – 1.55pm	**The Relevance of Dietary Sugars and Fats to Disorders of Mood, Behaviour and Learning** ***Dr Alex Richardson*** *(Founder/Trustee of FAB Research; Senior Research Fellow, University of Oxford; Author of 'They Are What You Feed Them')*
1.55pm – 2.25pm	**Sugar, Diet and Violence: A diet of Disaffection** ***Dr Bernard Gesch*** *(Senior Research Scientist, University of Oxford)*
2.25pm – 2.55pm	**Refreshment Break**
2.55pm – 4.00pm	**Sugar, Hormones and Addiction** ***Professor Robert Lustig MD*** *(Professor of Pediatrics, UC San Francisco; Author of 'Fat Chance: The bitter truth about sugar)*
4.00pm – 4.30pm	**Nutrition and Mental Health – Time for a New Paradigm?** ***Professor Malcolm Peet*** *(Consultant Psychiatrist, Doncaster and South Humber NHS Healthcare Trust; Honorary Professor, University of Sheffield and Sheffield Hallam University)*
4.30pm – 4.45pm	**Speakers' Panel – Q & A and Discussion**
4.45pm – 5.00pm	**Closing comments and Networking**

Pure, White and Deadly – A legacy remembered

by Professor Michael Yudkin, Professor Emeritus of Biochemistry, University of Oxford

In *Pure, White and Deadly* (1972), John Yudkin summarised the research that he and his colleagues had carried out since the publication in the Lancet (1957) of his paper 'Diet and coronary thrombosis: Hypothesis and fact'. The Lancet paper had studied the alarming rise in the number of deaths from coronary thrombosis since the 1920's, and had sought to establish a relationship between that rise and changes in diet. It concluded that there was no good evidence that any single dietary factor was the cause of coronary thrombosis, refuted the suggestion that the consumption of fat, or of a particular sort of fat, was to blame, and proposed that the aetiology of coronary heart disease was multi-factorial.

A few years after publishing his Lancet paper, John Yudkin started to suspect that over-consumption of sugar was in fact one of the causes not only of coronary heart disease but also of obesity and diabetes. This suspicion was derived in part from his work in devising a reducing diet for overweight people, in part by thinking carefully about the diet that was probably eaten by our pre-agricultural ancestors, and in part by the demonstration that when groups of people increased the amount of sugar in their diet (for example when they moved to another country) their incidence of diabetes greatly increased. He also noted that modern methods of food manufacture allowed sweetness (the factor responsible for the palatability of fruit) to be separated from the factors that give fruit its nutritional value (Vitamin C and certain minerals). Sugar could be easily and cheaply purified and added to a whole range of manufactured foods to make them attractive.

There are several critical questions which, in 1972, it would have been reasonable to ask about the conclusions of *Pure, White and Deadly*. If such questions had been asked in good faith they would have generated support for further research, and this would have either confirmed or disproved the book's contention that sugar is partly responsible for the increased incidence of several serious conditions. Instead, the book was disparaged and its author ridiculed. It seems possible that this reaction, in the years following the book's publication, is in part to blame for today's epidemics of diabetes and obesity.

- In *Pure, White and Deadly* (1972) John Yudkin set out the evidence for his belief that excessive consumption of sugar was a factor in the high incidence of obesity, diabetes and coronary thrombosis.

- This belief was not based on long-standing prejudice. In 1957 Yudkin had reviewed the epidemiology of coronary thrombosis and had not then concluded that sugar was an important cause of the disease.

- His later work on treating obese patients, his studies of the probable diet of our pre-agricultural ancestors, and epidemiological and laboratory work by others caused him to suspect sugar as an important factor in the aetiology of several diseases.

- The conclusions of *Pure, White and Deadly* were disparaged when the book was published. Had they been taken seriously, today's epidemics of diabetes and obesity might well have been mitigated.

About Michael Yudkin

Professor Michael Yudkin is an Emeritus Fellow of Kellogg College, University of Oxford, where he held a Fellowship from 1993 to 2005. He was appointed a University Lecturer in Biochemistry at Oxford in 1966, and was made a Professor in 1997. He is also the son of the British scientist, John Yudkin, author of 'Pure, White and Deadly – How sugar is killing us and what we can do to stop it'. First published in 1972, this well-researched book put forward a compelling argument that sugar was bad for our health. At the time, however, policymakers and the medical establishment essentially ignored its message, choosing instead to 'demonise' dietary fats as the main cause of heart disease and (by implication) obesity and related conditions. This ground-breaking book was recently re-published, with a foreword by Robert Lustig.

The Relevance of Dietary Sugars and Fats to Disorders of Mood, Behaviour and Learning

by Dr Alex Richardson, Senior Research Fellow at the Centre for Evidence Based Intervention, University of Oxford; and Founder Director of the UK charity, Food and Behaviour Research

To date, remarkably little attention has been paid to the links between diet and human behaviour in research, policy or practice in the UK, US and other developed countries. Public health advice has long prioritised the reduction of 'dietary fat' to combat both cardiovascular disease and obesity, effectively encouraging diets high in sugar and other refined carbohydrates. Accumulating evidence indicates that this has not only failed to tackle the growing crisis in obesity and related physical disorders, but may have contributed to a mental health crisis that has already reached epic proportions.

The annual cost of mental ill-health in the UK rose from £77bn-£105bn between 2007-10 on UK government figures (exceeding that of heart disease and cancer combined); and each year, over 1/3 of the European population suffers from a diagnosable neurological or psychiatric disorder (mostly untreated). In children, the most prevalent conditions are ADHD, autism and related neurodevelopmental disorders of behaviour and learning; in adults, stress-related conditions including sleep problems, anxiety, depression, and substance use disorders; and in older adults, age-related cognitive decline and dementia.

Nutrition is as important for the proper functioning of the brain as it is for the body – and the 'demonisation' of dietary fat (as a whole) has been particularly unhelpful, as 60% of the brain's dry mass is fat – and it is the type and balance of fats (not the overall quantity) that is critical to mental and physical health. Modern, western-type diets still contain 'bad fats' (such as toxic 'trans fats'), and are relatively lacking in 'good fats' such as omega-3 critical for normal brain development and function. Controlled trials show that increasing omega-3 intakes (specifically the long-chain forms, EPA and DHA) may be of benefit in many mental health conditions - particularly ADHD and related behaviour and learning disorders, depression and other mood disorders. Conversely, omega-3 deficiencies – particularly in early life – increase risks for both mental and physical ill-health, and new evidence suggests they may also exacerbate adverse effects of sugar on brain function.

Excessive consumption of sugar and other refined carbohydrates (and a corresponding lack of fibre and essential micronutrients) is the other aspect of western-type diets that appears to have pathological effects on health. In humans, data linking sugar with mental health and performance remains largely correlational / circumstantial, but the totality of that evidence has become compelling (particularly with respect to mood/impulsivity disorders and dementia) – and increasing evidence that sugar may be as 'addictive' as alcohol or tobacco can no longer be ignored.

Mental health disorders are always complex and multi-factorial, requiring effective action on many fronts. All start in early life, when the effects of nutrition on future health are most profound – but ignoring the role of diet in mental as well as physical health at any age is a recipe for disaster. Dietary guidelines and current food policy merit urgent revision in the light of current scientific evidence; and this means that for vulnerable groups – including children and mental health service users – the 'freedom of choice' argument peddled by the food industry can no longer go unchallenged.

SUMMARY OF KEY POINTS:

- Mental health disorders have reached crisis levels in the UK and other developed countries, and more effective approaches for their prevention and management are urgently needed. These must include attention to nutrition, as this is fundamental to the development and functioning of the brain and nervous system, as well as to physical health.
- Food policies and 'healthy eating' advice since the 1970s have led to excessive consumption of both sugar and 'bad fats', and relative deficiencies of 'good fats' – notably omega-3, which are essential for normal brain development and function (as well as for cardiovascular and immune system health).
- Controlled trials show that increasing dietary intakes of omega-3 (specifically the long-chain forms found in fish and seafood, EPA and DHA) can reduce symptoms of ADHD and related disorders of behaviour and learning, and may also be of benefit in depression and other mood disorders (as an adjunctive treatment).
- Current evidence that excessive sugar consumption directly affects mood, behaviour and cognition remains largely circumstantial, but the totality of the evidence is now compelling, including converging evidence that sugar may be as addictive as alcohol and tobacco.
- Better education and training of health professionals and the public is urgently needed on the importance of diet for mental as well as physical health, to reflect the latest scientific evidence in this field. In practice, however, healthier eating will remain impossible for many vulnerable groups – including children and mental health service users - without significant changes in public health policy with respect to food and diet.

About Alex Richardson

Dr Alex Richardson is a Founder/Trustee of FAB Research and a Senior Research Fellow at the Centre for Evidence Based Intervention, University of Oxford, having previously been based at Oxford's Dept of Physiology, Anatomy and Genetics from 1987-2007. She is internationally known for her work on the role of nutrition in behaviour, learning and mood, and is one of the world's leading researchers on the influence of omega-3 and other dietary fats on mental health and performance, particularly in relation to developmental conditions such as ADHD, dyslexia, depression and schizophrenia. Her research has always been multi-disciplinary, and currently involves both experimental studies and nutritional treatment trials. Alex is much sought after as a speaker for public, professional and academic audiences both nationally and internationally. She has over 80 research publications to date, and is also author of 'They Are What You Feed Them'.

Sugar, diet and violence: A diet of disaffection

by Dr Bernard Gesch FRSA, Department of Physiology, Anatomy and Genetics, University of Oxford

Since Industrialisation we have made unprecedented changes to our diet with little or no systematic testing for effects on our brain. The UK consumption of sugar is estimated to have increased sevenfold in the last 200 years. Such deleterious dietary changes disproportionately affect adolescents who seem to be the main marketing target for sugary foods. Furthermore, the maximal impact is likely to be among disaffected young people who typically are dislocated from routine access to healthy foods. These young people form a large proportion of the prison population and there are concerns that insufficient attention is paid to their health. Hence their diet tends to be poor compared to international standards of dietary adequacy, which typically are set to protect the heart but not for optimal brain function. We will review the limited evidence testing the relationship between sugar consumption and behaviour.

We tested what happened to the behaviour of violent young adult prisoners (18-21 years) when essential nutrients missing from their diets were reinstated. We used food supplements as an analogue of a better diet because it provided the possibility of a placebo control. On a random basis, where neither the volunteers, prison staff nor researchers in the prison knew who was getting which type, 231 volunteers were given either placebo or real capsules containing broadly the daily requirements of vitamins, minerals and essential fatty acids. The number of proven offences committed by each prisoner was monitored before and while taking supplements. The result was that those who received the extra nutrients committed significantly (26.3%) fewer offences compared to placebos. Those consuming real supplements for at least two weeks committed 37% fewer (highly statistically significant) of the most serious offences such as violence. These findings have been replicated by the Dutch Ministry of Justice, their double blind study found a 48% difference between groups. These effects will depend on the quality of the dietary baseline and we have yet to remove the excess of sugar from the diet. If these studies are widely replicated and they need to be, we may have a simple and humane means to help reduce and prevent a significant proportion of violence and antisocial behaviour. This should also work in the community because it is not about where you eat but what you eat. Indeed, criminal justice systems are often over-represented with ethnic minorities but providing a more nutritious diet is never going to be discriminatory to these young people. Thus, it has been posited that a poor diet may be a modifiable causal factor in antisocial behaviours; a factor still ignored by the criminal justice system.

We question why the criminal justice system largely ignores brain function when its role is to judge behaviour. And why for instance young prisoners can purchase unrestricted quantities of sugar in prison. We consider if we would we be better off providing our children with a more nourishing diet than spending £45,000 per year on sending one young person to prison.

- Crime is not brainless, it involves a brain. The question is if the brain is working properly.
- What you have just eaten may turn out to be a better predictor of what you are about to do than what you have just done!
- Tough on crime, tough on the causes of crime is an excellent strategy but it requires us to begin identify what these causal factors are.
- The only risk of better diet is better health.
- Diet is a major determinant of our brains working environment.
- If we are what we eat then changing our diet will change us.

About Bernard Gesch

Dr Bernard Gesch is a Senior Research Scientist at the Department of Physiology, Anatomy and Genetics, at the University of Oxford. Bernard is internationally known for his pioneering research into the links between diet and antisocial and criminal behaviour. In the late eighties he established a programme combining nutritional and social approaches to offending which some UK Courts used successfully as an alternative to imposing custodial sentences on persistent juvenile offenders. With the co-operation of the Home Office, Bernard and colleagues went on to conduct a carefully controlled clinical trial, supported by the charity Natural Justice, that Bernard founded, to test empirically if better nutrition could significantly improve the behaviour of maximum-security prisoners. It did! Bernard now collaborates internationally to replicate these findings, and is currently working with eminent colleagues from several institutions, including the Medical Research Council and the Institute of Psychiatry.

Sugar, Hormones and Addiction

by Professor Robert H Lustig, MD, Division of Pediatric Endocrinology, University of California, San Francisco

The obesity epidemic is no doubt being fuelled by a secular trend in caloric excess. However, humans have a biochemical negative feedback mechanism called leptin, which should prevent such caloric excess. Clearly, the leptin negative feedback pathway is being perturbed in specific and stereotypic ways.

Leptin acts in two brain areas to reduce food intake. In the hypothalamus, leptin stimulates the melanocortin system, which decreases caloric intake and increases energy expenditure. In the "reward" pathway, consisting of the ventral tegmental area and nucleus accumbens (VTA-NA), leptin reduces dopamine neurotransmission and extinguishes the reward signal. When leptin levels fall, the hypothalamus senses starvation, and the VTA-NA increases the reward of food, thereby fomenting increased consumption. In obesity, defective leptin action occurs through two mechanisms. First, leptin transport across the blood-brain barrier is impaired. This is likely mediated through hypertriglyceridemia, a common manifestation of insulin resistance. Second, central leptin signal transduction is impaired, both at the hypothalamus, and at the VTA-NA. This may also be mediated through hyperinsulinemia. Reduction of hyperinsulinemia not only promotes weight loss; it also alters macronutrient food preference, reducing carbohydrate intake. One possible proximate cause of both these indirect mechanisms of leptin resistance is the rise in fructose consumption, which induces hypertriglyceridemia and hepatic insulin resistance.

There are also direct effects of sugar on the VTA-NA. In animal experiments, chronic intermittent sucrose administration has been shown to induce four phenomena associated with addiction and dependence: 1) bingeing; 2) withdrawal; 3) craving; and 4) cross-sensitization with other drugs. Indeed, obesity and drug addiction exhibit similar effects on dopamine neurotransmission, pharmacology, and neuroimaging. Thus, sugar appears to have specific effects on the "reward" system of the brain, which results in a "vicious cycle" of consumption, insulin resistance and hypertriglyceridemia, and continued consumption.

Other substances that stimulate the reward pathway (e.g. nicotine, ethanol) have required a combination of both education and public policy efforts to curtail consumption. It is suggested that obesity will require a similar education/public health approach.

- Leptin signalling extinguishes both hunger and reward, but insulin extinguishes leptin signalling.
- By driving insulin resistance, sugar drives both "brain starvation" and increased need for reward.
- Sugar also drives dopamine, which fosters reward, but then tolerance develops, requiring more sugar.
- Sugar resembles alcohol in terms of its liver and brain effects; resulting in a vicious cycle of consumption and disease.

About Robert Lustig

Professor Robert Lustig MD is Professor of Pediatrics in the Division of Endocrinology at the University of California, San Francisco, and Director of the Weight Assessment for Teen and Child Health (WATCH) Program at UCSF. He is a noted neuro-endocrinologist, with extensive basic and clinical training involving hypothalamic development, anatomy and function. In recent years he has developed a strong following in the nutrition and health world with his warnings about the dangers of consuming too much sugar. Professor Lustig's work has shown how and why the effects on mood and behaviour of a high sugar intake will undermine conventional approaches to the reduction of obesity, ie why attempts to 'eat less and exercise more' simply do not work. His work has helped the scientific community to make progress in the fight against both obesity and the related development of chronic diseases. He is also leading the public relations fight in the US against the use of high fructose corn syrup that is prevalent in so many packaged foods today. He has just released his new book, 'Fat Chance: The bitter truth about sugar'.

Nutrition and Mental Health - Time for a New Paradigm?

Professor Malcolm Peet, Consultant Psychiatrist, Doncaster and South Humber NHS Healthcare Trust; Honorary Professor, University of Sheffield and Sheffield Hallam University

There is a strong and well-recognised association between major mental disorders such as depression and schizophrenia, and diseases of the metabolic syndrome. This increases the personal, social and economic burden of mental disorder. People who suffer from major mental disorders eat a very poor diet that is characteristically high in sugar and fat, and it is recognised that this diet contributes to the high rate of metabolic syndrome in these individuals. However, little credence has been given to the notion that the same poor diet might also be a causative factor for the mental disorder itself. The composition, and with that the function, of the brain is affected by what we eat, and from an evolutionary perspective it would be surprising if the nutritional requirements of the brain were different from those of the rest of the body.

Evidence will be presented from case-control, cohort and ecological studies, to show that mental disorder is promoted by diets that are high in sugar and fat, whereas diets that are high in fruit, vegetables and fish have a protective effect. These are the same dietary associations that are found with regard to the metabolic syndrome.

It is concluded that the diet required for optimal brain function is the same as that required for optimal bodily function. This leads to a new paradigm for the understanding and management of mental disorders such as depression and schizophrenia, in which close attention is paid to nutrition as a causative, preventative and alleviating factor.

- There is a strong association between mental disorder and the metabolic syndrome.
- It is recognised that poor diet contributes to the high rate of metabolic syndrome in this group.
- There is evidence that the same dietary factors that are important in relation to metabolic disorder can also promote or alleviate mental disorder.
- Nutrition should be included as part of the core management and prevention of mental disorder.

About Malcolm Peet

Professor Malcolm Peet is a Consultant Psychiatrist with Doncaster and South Humber NHS Healthcare Trust, and Honorary Professor at the University of Sheffield and at Sheffield Hallam University. From a research background in psychopharmacology, he has been studying the role of nutrition in mental health since 1990. He pioneered research into the role of omega-3 fatty acids in both depression and schizophrenia, including controlled treatment trials, and remains at the forefront of international research in this field. He has also shown that schizophrenia is more severe in countries where the national diet is higher in sugar and saturated fats, while depression is more common in countries with lower intakes of omega-3 from fish and seafood. These findings could help to explain why depression is more common and schizophrenia more severe in developed countries than in the developing world. Professor Peet continues to investigate the links he has found between diet and mental health, and to explore plausible mechanisms. More recently, his research has also focused on the practical applications of nutritional interventions within mental health services in the UK, and their implications for professional training. He has published and lectured extensively on nutrition and mental health, and is highly skilled at communicating the latest research and its implications to public and professional as well as academic audiences.

Sugar and the Brain:
Food Choice, Addiction and the Mental Health Crisis
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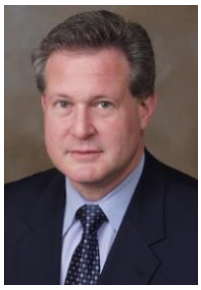
Speakers and Chair



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