



ASSOCIATE PARLIAMENTARY FOOD & HEALTH FORUM



The links between diet and behaviour

3.30-5.30pm, Wednesday 25 April 2007

House of Lords Committee Room 4a

Minutes

Introduction

Lord Rea welcomed members and guests to the meeting and introduced the speakers.

Professor Neil Ward, Surrey University

Professor Ward is an expert in trace element analysis and the relationship to human health and the environment. He has studied the involvement of trace and ultra-trace elements in human fluids and tissues for more than 35 years in relation to many human disorders, especially pre-conceptual problems, birth defects, infertility, hyperactivity and anti-social behaviour in children, and numerous metabolic and neurological diseases.

Neil Ward said that in the limited time available he would only be drawing attention to some of the key points in relation to chemical substances and human behaviour, ADHD in children and trace elements and anti-social behaviour, but more detailed information on his views is available in the statement submitted to the Forum.

Neil said the relationship between chemical substances and human behaviour is a complex interplay of factors. We know there is a direct link between diet and behaviour, for example, drinking a bottle of vodka on an empty stomach will have clear consequences, and we accept evidence about the effect of alcohol, non-medical drugs, hallucinogenic agents, therapeutic drugs and chemical solvents

Humans can be affected by chemicals chemical substances through their diet or environmental exposure.

A great deal of work has been done on the effects of dietary deficiency, for example, with magnesium, copper, zinc and iron.

Neil paid tribute to the work of Vicky Colquhoun and Sally Bunday, co-founders of the Hyperactive Children's Support Group (HACSG), who had worked on the issue of the link between trace elements and attention deficit hyperactivity disorder (ADHD) for more than twenty years, and the support he had received from the Oxford Allergy Support Group. A summary of their findings is that children with ADHD have low blood serum and hair/nail iron, chromium, magnesium, selenium and zinc; and raised blood serum and hair/nail levels of lead, cadmium and aluminium. Professor Derek Bryce-Smith pioneered work in this field. Neil became interested in this area when he met a boy who told him he could not drink an orange drink or he would "go bonkers".

Neil's interest in food colouring coincided with the period in which a growing number of colourings were being used, such as tartrazine (E102) and sunset yellow (E110). Work in this field led to the development of the E code numbering system.

Chairman: Lord Rea
Vice-Chairmen: Dr Ian Gibson MP
& Baroness Miller of Chilthorne Domer
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Treasurer: Baroness Gibson of Market Rasen

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During October 1992 and June 2000, in association HACSG, the Oxford Allergy Support Group and various other child health charities, a series of studies were undertaken to assess the chemical factors influencing children with hyperkinetic disorders. Neil showed a slide (slide 5) which showed the percentage of hyperactive (HA) and control (C) children reporting a positive response to foods or chemical substances in foods, beverages and the domestic environment. In the initial study period more than 60% of the HA children reported a positive response (that is an increase in behavioural problems) in relation to synthetic colourings and flavourings, food and beverage preservatives, cows' milk and associated products, chemical detergents and perfume. In contrast, 12% of the control group also reported similar, but generally milder, responses to synthetic colourings or flavourings and chemical solvents.

Vicky and her colleagues also reported that there are many natural chemicals, for example salicylates in oranges, which triggered a response in children with ADHD.

Neil set up a randomised controlled trial (RCT) to measure the effect of tartrazine on children, in which the children's blood serum and urine were analysed. Slide 6 illustrates the link between zinc and tartrazine. The first thing they noticed was that the ADHD children had relatively low levels of zinc (we know believe this is because they suffer from leaky gut syndrome). When the children drank the tartrazine drink their low levels of zinc became further depleted – they were excreting it at a high rate through their urine. The same effect was noticed in the control children, but their zinc levels were depleted less significantly and more slowly.

Slide 7 illustrates the findings of a study which measured the way in which the behaviour of children with ADHD changed within 30 minutes of consuming the food colours: tartrazine, sunset yellow and amaranth. Of the 23 children given tartrazine 16 became aggressive, 4 children's behaviour deteriorated to the point at which they became violent and 12 suffered from poor coordination. 8 of the 12 children given sunset yellow became overactive and 8 of the 12 children given amaranth became aggressive.

Neil explained that tartrazine and sunset yellow are azo dyes and it is believed that they could be acting as chelating agents that bind the available blood zinc in the body to form complex metals, which are then excreted. Azo dyes inhibit trypsin/amylase activity and low proteolytic enzyme activity would induce inadequate digestion. This could help explain why many ADHD children are unable to absorb all the nutrients in the food they eat. However, though azo dyes are associated with behavioural changes in hyperactive children, the mode of action is not known.

In the Feingold diet, azo dyes are eliminated and this can have a dramatic effect on the behaviour of some hyperactive or ADHD children.

Many studies are looking at the relationship between aggressive behaviour in ADHD children and reduced levels of melatonin and serotonin (5HT). We know that zinc regulates melatonin biosynthesis: reduced zinc absorption/metabolism limits the pineal gland's ability to synthesize melatonin. We also know that zinc affects immunity to infection and low zinc levels impairs cell-mediated immunity. Low zinc levels are associated with gut permeability (thus hyperactive children may have a more leaky gut) and zinc deficiency is linked to gastrointestinal changes in enterocytes and damage to the microvilli.

Neil expressed concern about the growing use of Ritalin (methylphenidate) to treat children with ADHD. In the USA the use of Ritalin has been reviewed (Terrass, Nutritional Practitioner, 2.2, 24-27. 2007). Ritalin is a stimulant, which has a pharmacological resemblance to amphetamines. According to the USDEA (United States Drug Enforcement Administration) it is a "cousin" of cocaine and has many of the same properties. The review of its use in the USA found that its use had increased by 600 fold in the 1990s and that in certain schools some 20% of the children were taking it. Its use is becoming similarly common in the UK. However, this drug is simply a means of controlling the symptoms of ADHD, it does not address the causes. Moreover many of the reported side effects of Ritalin are the same as those associated with ADHD. They include

irritability, mood swings, nausea and stomach pain, appetite loss, skin rash, insomnia, depression, delayed growth. Given that Ritalin is inherently habit-forming and it is difficult to assess the benefit against the risks, the sense of its widespread use should be questioned.

We know that nutritional and dietary intervention can be used to manage ADHD children. Elimination diets in which the foods to which the children are intolerant are removed from their diet can help. However, this is not straightforward. There is no one food to which all children respond and no one child is affected by only one food, whilst the same child can be affected differently by the same food over time. Foods which commonly cause problems for ADHD children include sugar, food additives, dairy products, wheat, eggs, chocolate, yeast, citrus, corn, soy, salicylate-rich foods (cherries, apples, berries, grapes, oranges, tea, tomato). Certain trace elements are clearly important for these children, including essential fatty acids, iron, chromium, selenium and zinc.

Moon and Marlow published a study (Biol. Trace Elem. Res. 11, 5-12, 1986) which suggested that aluminium (as measured by hair-aluminium concentration) is associated with anti-social behaviour. It is believed that aluminium competes for the binding sites of biochemical receptors of other metal ions (iron and zinc) and a suboptimal dietary intake of zinc and/or iron may explain the raised uptake of aluminium in the children with behavioural problems.

Professor Derek Bryce-Smith and his colleagues have done a lot of work looking at lead. Three studies (Needleman *et al.* 1990, New Engl. J. Med. 322, 83-8; 1996, JAMA 275, 363-69; and 2002, Neurotoxic Teratology 24, 711-17) led to a great deal of controversy in the USA.

These studies suggested the neurological effects of lead relate to acetylcholine, catecholamines, dopamine and GABA transmitters; lead acts as an anti-nutrient hindering the utilisation of magnesium, zinc and vitamin B1; and raised lead levels in children are linked to reduction in IQ, negative ratings by teachers for classroom behaviour, juvenile delinquency and increased violent behaviour. Such evidence led Canfield and his colleagues to conclude in 2003 that "there cannot be defined a safe level of lead in children – even at lower than 3 mcg/dl lead, effects can be expected.

Finally Neil Ward emphasised the importance of water and hydration. The human brain is more than 75% water, and it is very sensitive to the amount of water available to it a 2% drop in body water can trigger fuzzy short-term memory, trouble with basic math, and difficulty focusing on the computer screen or on a printed page. Mild dehydration will slow down one's metabolism as much as 3%. The effects of dehydration on the body range from mild (more concentrated urine, dry skin, mucous membranes, and lips and thirst) to moderate ("doughy" skin that doesn't bounce back when pinched, dizziness, vertigo, lightheadedness, headache, problems concentrating, drowsiness impatience and extreme irritability) to extreme thirst (and death). Neil Ward and his colleagues suggested that children should be allowed to drink whenever they wanted to in Surrey schools and this led to a significant improvement in behaviour within a month.

Professor Ward summarised his views by concluding that there is: strong evidence of a link between trace element status and human behaviour; trace elements are derived both from the diet and the environment; many of the mechanisms are as yet unknown; elimination produces positive improvements in behaviour; and more research is needed to unravel the mechanisms by which trace elements affect behaviour.

Lord Ramsbotham

Following a distinguished career in the army, Lord Ramsbotham served as the Chief Inspector of Prisons for England and Wales from 1995-2001. He is involved in many organisations supporting ex-offenders, serves on the Advisory Board of Youth at Risk and he is a Vice-Chairman of Natural Justice.

Lord Ramsbotham said he hoped the FHF inquiry would look to the future rather than concentrate on the past. Natural Justice has had a frustrating time over the last ten years, while it has waited for permission and the funding to enable it to undertake a larger study across the prison population to see whether its 1997 findings can be replicated. They hope now that they will soon be able to undertake a study across several prisons, including Hindley near Manchester. Local Government in Manchester is very interested in the project and would like to extend it to the community living near the prison. The Governor at Hindley Prison is also personally very interested and committed to the project. Natural Justice supports Bernard Gesch's work at Oxford.

Natural Justice hopes that this next study will persuade decision makers that there is something they can do to address the needs of the vulnerable group of people who make up the prison population.

Bernard Gesch of Oxford University & Natural Justice

Bernard Gesch is the Director of Natural Justice and a senior researcher in the Department of Physiology, Anatomy and Genetics at Oxford University. He was responsible for the key UK study which indicated a clear link between nutrition (vitamins, minerals and fatty acids) and anti-social behaviour in HM Young Offenders Institution Aylesbury (undertaken in 1997 and published in 2002).

Bernard said the aim of Natural Justice is to find new more effective and humane ways to tackle anti-social and criminal behaviour. They are bringing together a team of natural and social scientists to investigate what causes antisocial and criminal behaviour because they believe the evidence from the natural sciences that is relevant to these problems is largely ignored in our criminal justice system.

Their underlying hypothesis is that we have made major changes to modern diets in a relatively short space of time with little or no systematic examination of the potential impact of these changes on brain function or behaviour. If these changes in diets are causing an increase in anti-social behaviour it should follow that a better diet will cause a decrease in these problems. But this depends on the dietary baseline.

Bernard showed some slides (4 to 6) which showed the high number of children whose daily intake is less than the recommended level for vitamin A, iron and zinc, which are among the most common nutrient deficiencies worldwide. Bernard made the point that most prisoners were found to have better levels of iron and vitamin A than people living in the community because they are provided with regular meals, which include healthy choices. In fact when they examined the prisoners they found that very few of them were below the reference nutrient intake (RNI) for iron and vitamin A, but many were below recommended intakes in zinc.

Zinc has a biophasic relationship with serotonin (a regulatory role affecting the availability of serotonin in the brain) and lower levels of serotonin are associated with violence. Many nutrients are required for brain function: slide 7 illustrates the nutrients that are required for a neonatal diet and brain development up to six years of age.

Professor Raine in California published a longitudinal study trial in 2003 (Raine, A et al. *Am J Psychiatry* 2003; 160:1627–1635) which found that eighty-three children given an enriched nutritional and social environment aged 3 to 5 years were significantly less likely to be involved in antisocial behaviour at age 17 years, or criminal behaviour at age 23 years, compared with 355 matched controls. The same results from early intervention were evident from a second study (Liu, J., et al, (2004) *Am. J. Psychiatry* 161 (11), 2005–13).

Nutrients are not only important during pregnancy, when the brain is first developing, but also during the late teens when there is secondary brain development. If you look at the peak age for anti-social behaviour, it tends to be in the late teens and it is notable that girls, whose development

is much more linear than boys are less involved in anti-social behaviour, whereas boys who tend to be subject to development spurts are more highly represented in the criminal justice system. Bernard showed a slide (slide 10) which described a typical daily diet of a young offender. It consisted largely of cups of tea or coffee with sugar, fried chips and egg, white bread, sweets and cake. The individual did not eat breakfast or any fruit or vegetables. He drank alcohol if he had the money to buy it. Bernard said this suggested the results of the National Diet and Nutrition Surveys may present a best-case scenario for the socially disaffected.

Bernard referred to a significant history linking diet to behaviour. As far back as the 1820s, the Quakers had referred to the significance of a good diet in addressing criminal behaviour. However, the classic criminal justice model assumes that antisocial behaviour is purely matter of free will. Bernard questioned how free will could be exercised without involving the brain and how the brain could work properly without an adequate nutrient supply.

Bernard described the work of Schoenthaler, who published around 14 trials in which the diet of offenders had been improved by adding different nutrients. One of his experimental studies involved 3000 imprisoned juveniles, whose snack foods were replaced with healthier options containing reduced refined and sugary foods. There followed a 21% reduction in antisocial behaviour over 12 month period, a 100% reduction in suicides, a 25% reduction in assaults and a 75% reduction in the use of restraints (Schoenthaler, S.J Int J Biosocial Res. 1983; 5(2): 99-106).

Bernard showed a slide which showed that the annual intake of sugar per person had increased from less than 10 kg in 1820 to nearly 70 in 2000. He suggested this does beg the question as to what is regarded as a "normal" diet at the present time.

Schoenthaler did conduct a placebo-controlled, double-blind, randomised, experimental trial using the US recommended daily amount (RDA) of minerals and 300% of US RDA of vitamins with 62 13–17-year-old male and female incarcerated juveniles. The active group committed 28% fewer rule violations compared to controls ($p < 0.005$). The results were most effective for those with low baseline Vitamin C, thiamin, niacin, pantothenic acid, pyridoxine, and folate. (Schoenthaler, et al. (1997). J. Nutr. Environ. Med. 7, 343–52)

Schoenthaler's work was criticised in the USA because it did not always adhere to the standards of rigorously controlled medical scientific research but, Bernard suggested, the criminal justice system does not have sound scientific evidence to underpin its views as to the causes of crime and Schoenthaler's work compares favourably with that.

The Home Office itself has acknowledged that weak research design has contributed to the lack of knowledge about 'what works' and that "progress is often thwarted by Government programmes and strategies that are not based on rigorous evidence". One also has to consider the baseline against which changes in crime trends are being measured (slide 16 illustrates the UK crime trends over 100 years).

The trial Bernard conducted in 1996-7 set out to test the hypothesis that changes in diet could reduce the incidence of recorded offences by young offenders in prison. The trial had a double blind, placebo controlled, stratified, randomised experimental design with up to nine months baseline and up to nine months treatment. The supplements were randomly distributed by prison unit using a coded system so that no one in the prison knew who got what. Thus, the only systematic difference between the active and the control groups should be the result of what was in the capsules. Anti-social behaviour was measured by Governor's reports and Minor reports. The design was agreed in advance with the Home Office, which agreed that 18-21 year old male offenders should be involved.

The supplements given to the offenders broadly represented 100% of the recommended daily intake of vitamins, minerals and essential fatty acids, thus bringing them up at least to the level of essential nutrients recommended by the Government. The problem was not that the prisoners did not have access to a good diet, but many of them made unhealthy food choices. (Slides 20, 21

and 22 describe the supplementary vitamins, minerals and essential fatty acids provided in the trial). Bernard clarified that 80% of the essential fatty acids provided in the trial were omega-6 and only 20% was omega-3. The supplements contained Linoleic Acid 1260mg, Gamma Linolenic 160mg, Eicosapentaenoic Acid 80mg and Docosahexaenoic Acid 44 mg. The reason for the choice of this omega-6 and omega-3 ratio was that an earlier study had found lowered levels of omega-3 and omega-6 in violent offenders when compared to age matched non-offending controls (Corrigan, F.M. et al. *J Forensic Psychiatry*. (1994) 5, 1, 83-92). At the time their trial was designed, the trials showing a link between omega-3 levels and childhood behavioural disorders had not been published. In their next study they propose to provide 80% omega-3 and 20% omega-6

Slides 23-25 illustrated the results of the trial and show that the normal prison diet had no effect on the behaviour of the prisoners, whereas when the nutrients were provided there was a 26% reduction in the rate of recorded disciplinary incidents and a 37% reduction in the rate of more serious offences, including violence, reported to the Governor.

The trial was peer reviewed by: Professor Curnow, President of the Royal Statistical Society RSS, and the results were independently analysed by Professor Crowder of the University of Surrey, and Professor Smith of the University of Southampton and a former President of the Royal Statistical Society. The ten month Home Office review involved Professor Copas of the University of Warwick. A report of the findings was agreed in December 1998.

Bernard showed a slide (slide 27) that demonstrated the high re-offending rate of prisoners after two years in custody and said that this made people sceptical that anything could be done to change such patterns of behaviour.

The diets eaten by the offenders in prison were probably better than those consumed in the community. Bernard said they don't know if the effect came from ensuring all prisoners reached the UK Government's dietary standards or because some would have exceeded them, but it is not where you eat that is important but what you eat. Certain dietary choices - including fish consumption, a balanced intake of micronutrients - and a good overall nutritional status have also been associated with reduced rates of violent behaviour. The World Health Organisation regards violence as a communicable disease (WHO, "Healthy Environments: Towards an estimate of the environmental burden of disease" 2006. 55).

Bernard suggested that a nutritional approach offers a much less expensive and more cost-effective way to tackle anti-social and criminal behaviour given that it costs 0.2% of the cost of custody. Cognitive skills approaches in prisons have cost £150,000,000 and were found to be ineffective (Cann et al. Home Office findings 226, 2003). The public cost of evaluating the nutritional approach was £1,000 and was found to be highly effective (Gesch et al. *Brit. J. Psych.* 2002. 181, 22-28).

Bernard also regards a nutritional approach as less risky. With the conventional approach to offending, intervening too early can be prejudicial leading to an escalation of offending, whilst intervening too late can result in unchecked offending. With the nutritional approach the only risk from early intervention is better health.

Bernard suggested that future research should seek to identify more optimal nutrient dosages to minimise anti-social behaviour. It cannot be assumed that greatly exceeding the recommended daily amount (RDA) for vitamins and minerals will be beneficial. Schoenthaler and Bier found in a study of 402 Californian prisoners that those given 100% of the US RDA of vitamins committed fewer offences (a reduction of 30%) than those given 300% of the US RDA (an increase of 42%), (Brostoff and Chalcoombe, *Food, Allergy and Intolerance*, Saunders 2002). We need to establish the optimum range and balance of nutrients for the brain, bearing in mind that most nutrients interact and the clinical benefit will vary according to existing dietary baselines.

Bernard suggested we should use a weakest link in the chain model for nutrition, not a pharmacological model. In order to isolate the effect of one nutrient we need to ensure that all other nutrients are there in appropriate quantities

Bernard's next study will re-test the Aylesbury findings. It will be conducted in three institutions including juveniles, with a projected population of 1000+ (to give a power of >98%). The study will investigate possible mediating mechanisms: including assessments of interpersonal relating; frontal lobe mediated tasks and heart rate variability. An additional aim will be to investigate the range and dosages of nutrients involved in reducing anti-social behaviour so that they can advise on dietary standards.

At the invitation of the Home Office, Natural Justice is also designing a double blind trial using nutrition as an adjunct to "Intensive Supervision and Surveillance Programmes".

Bernard recommended that dietary standards should be reassessed to take into account possible mental health, behavioural, developmental and cognitive parameters, particularly among socially disaffected populations; promising research needs to be replicated in large scale studies, ideally by experienced multidisciplinary teams; and Lord Ramsbotham recommended there should be more joined up leadership from the Government on this important broad ranging issue.

Questions

Baroness Miller of Chilthorne Domer (SM) asked if Bernard thought the Dutch Government had a more enlightened approach to these issues and whether other countries were also ahead of the UK in recognising the links between diet and behaviour. **Bernard** said yes. The Dutch had presented their evaluation to the Home Office in May 2004 saying they thought the Aylesbury trial was some of the best quality evidence they had seen and they intended to attempt to replicate these findings in their prison system. They thought it might allow them to save money while improving services. They had also recognised the implications of this field of research for their secure mental health system and using school diet as part of their primary crime prevention strategy. He said Norway, France and the USA are working in this area and he has recently had expressions of interest in his work from Australia. Bernard said the Dutch Ministry of Justice have tried to replicate his study. They have collected the data and about to present it to their Minister. Lord Ramsbotham offered to try to obtain the findings of the Dutch study and send it to the Forum and Bernard offered to send the Dutch comments on his work to the Forum.

Lord Baldwin of Bewdley (EB) expressed interest in the role of elimination diets in changing behaviour and said that a member of his family had been able to come off Lithium for bipolar disorder as a result of eliminating wheat and dairy. He asked if **Bernard** thought there was a weakness in the National Diet and Nutrition Surveys in that they did not involve underprivileged children. Bernard said they to try to include a representative cross section, but they are unlikely to include disaffected children who do not go to school and who do not benefit from regular meals. The prisoners were well nourished compared with the communities from which they came, but even in the prison population improving their nutrient intake led to a significant improvement in behaviour. There is every reason to think, therefore, that improving the diet of the disaffected in the community would lead to even greater improvements in behaviour because the dietary baselines are likely to be so much worse than those in prison. **EB** also asked for confirmation of the ingredients in the supplement to be used in the next trial and **Bernard** confirmed the ratio of omega-3 and omega-6 would be 80%:20% (reversing the original trial), but otherwise it would contain broadly the RDAs of vitamins and minerals.

The Countess of Mar asked if Bernard and his colleagues measured the toxins in the body at baseline as well as the nutrients. **Bernard** said they will be looking at a wide range of nutrients and some other factors, such as lead, homocysteine levels, and c-reactive protein which will indicate if the person was ill when the sample was taken. Prisons are ideal places to do this research because all sources of food are known but the logistics of undertaking trials in prison populations is difficult and they had to focus on a few key factors. He said they had noticed in

1997 that the prisoners' baseline diet involved the consumption of three times the recommended level of salt.

Courtney Van de Weyer of Sustain

Courtney Van de Weyer is the author of the Sustain report, "Changing Diets, Changing Minds: how food affects mental well being and behaviour" that was written, with the support of the Mental Health Foundation, in 2005 and published in January 2006. The report comments on research that appears to demonstrate a link between diet and mental health and to place that evidence in the context of a changing food system.

Courtney began by explaining that Sustain is an umbrella organisation which represents some 100 national public interest organisations working at international, national, regional and local level. It advocates sustainable food and agriculture policies and practices. Courtney, who had partially trained as a mental health lawyer, started Sustain's Food and Mental Health Project, which has sought to increase the awareness of the link between diet, mental health and behaviour. The Project initially produced the report "Changing Diets, Changing Minds: how food affects mental well being and behaviour", detailing the evidence of the link, along with a series of policy recommendations. The Project now works to implement those recommendations. It had proved to be a controversial project.

Sustain believes it is self-evident that there is a link between diet and behaviour. In their view it is simply not rational to accept – as people do – that the body is affected by nutrition, yet separate out the brain from this equation. The brain is a physical organ in the body, just as the heart or liver. The manifestation of the brain's processes are feelings and, ultimately, behaviour – as such, it is self-evident that nutrition affects mental health.

Courtney said there was a huge amount of anecdotal evidence of the link between diet and behaviour with both subtle and dramatic changes being reported. She suggested there was also a good amount of published evidence in the form of epidemiological and physiological studies and randomised controlled trials (RCTs).

Courtney suggested that most people agree that more research, particularly large scale RCTs, is needed but queried who would fund it. She suggested the pharmaceutical and food industries were unlikely to fund research that could be harmful to their interests. The food supplements industry typically limits its support to providing its own products for tests (and this could be counter-productive if the associated publicity was misleading). The remaining possible source of funding is the Government, but securing Government funding is very difficult.

If more research is to be undertaken we need to think about what should be researched. RCT's, with some exceptions, tend to test the effect of one nutrient via supplements because these can be relatively easily used in double-blind trials. However, humans do not eat nutrients – they eat food and the RCT structure risks misrepresenting how all nutrients in food interact.. Moreover behaviour is observed by several different sources, for example, teachers, parents and research staff and this can lead to different interpretations. She suggested that we still have much to learn about the effects of nutrients on the body, but we do know that food affects it. However, she does not believe that we will ever be able to "prove" this to the satisfaction of everyone.

Courtney said that there is evidence of the importance for behaviour of intake of essential fatty acids, including omega-3. But we need to consider why this has received so much attention in recent years. In part the explanation is the result of the discovery of plausible physiology, as described in the work of, for example, Michael Crawford. There is also evidence of a decrease of omega-3 in the food supply and in the diet and this is associated with an increasing incidence of anti-social and criminal behaviour. A number of trials in recent years have focused on this issue with some showing promising, if limited, results. However we also need to be aware that our appreciation of this issue may be affected by aggressive marketing by fish oil supplement companies; innovations in food technology which has made possible the encapsulation of omega-3

in other food products; a nostalgia for cod liver oil; and an increasing tendency to medicalise health. It is much easier to treat behaviour through a pill than to change the food supply!

Courtney pointed out that foods fortified with omega-3 are more expensive than their conventional alternatives and there is no evidence that consumers are deriving benefit from this additional expense. For example, the dosage of omega-3 available from a normal portion of the food may be much less than that used in trials where a positive effect was seen.

Sustain looked at a range of supplements on sale and found there was a massive difference in the dose, ratio and source of different long chain highly unsaturated fatty acids. Moreover, there is no evidence yet to demonstrate that healthy children (those who do not suffer from childhood behavioural disorders) benefit from essential fatty acid supplements.

Sustain is concerned to promote sustainable food and farming policies and it is worried about the effect which the hype surrounding the consumption of oily fish and essential fatty acids may have on fish stocks. As it is, fish stocks are seriously depleted (the UN's Food and Agricultural Organisation has estimated that 75% of the world's fisheries are fully exploited, over-exploited or significantly depleted) and this is at a time when the average person consumes less than the current recommended amount of fish and oily fish. If fish consumption increases as a result of changed or more emphatic advice, it could have a seriously detrimental effect on fish stocks. Courtney questioned why the FSA currently recommends people should eat two portions of fish a week, including one portion of white fish (by far the most endangered) when it contains relatively small amounts of essential fatty acids.

Sustain's view is that a balanced, healthy diet should be the preferred choice to supplements and we should seek policies that help and encourage every individual to eat a balanced, healthy diet, incorporating all of the necessary nutrients for the brain and, thus, mental health. A healthy diet is not an "alternative" approach it is essential to health.

Courtney offered some recommendations to the Forum. She suggested more research is necessary to establish the mechanisms by which nutrients affect behaviour. She suggested the Scientific Advisory Committee on Nutrition (SACN) could be asked to evaluate the evidence and make recommendations and she pointed out that they have a "Horizon Scanning" meeting in October. She said it might be most helpful if the Government would simply acknowledge a link between diet and behaviour because that could provide greater urgency for already proposed changes to the food system with significant benefits in terms of mental and physical health, as well as helping to remove the issue's "alternative" label. She strongly recommended that food in hospitals should be improved, there should be a sustained attempt to improve cooking skills, trans fats should be banned and the advertising of unhealthy food to children could be further restricted. She would like to see the links between diet and behaviour become more widely accepted, but she does not expect the training of knowledge of GPs to change significantly. She believes there is a strong case for dieticians being attached to GPs surgeries, so the GPs can refer patients for dietary advice rather than hand out prescription drugs.

In her final remarks Courtney drew attention to the success of school breakfast clubs. She argued there is widespread agreement on the evidence that breakfast leads to children performing better on mental tasks. She does not find it surprising that hungry children cannot concentrate in school and noted that poor school performance feeds a life-cycle of deprivation. She suggested there is a surprising level of need for breakfast clubs. Many children are simply hungry; it is not just that they are fed the wrong types of food served at home, many are not fed at all. Courtney said that many school breakfast clubs are under-funded and some do need to charge, but she strongly recommended that children who are entitled to free school meals should also be provided with a free school breakfast

Questions

The Countess of Mar made the point that some children simply will not eat breakfast even if it is offered to them. She asked why it is that we seem to know much more about, and accept, the link between nutrition and animal health but refuse to recognise this in humans. **Neil Ward** agreed and said that vets know far more about the nutritional health of animals than GPs know about humans. **Bernard** said that Natural Justice's view is that the ideal would be for all people to achieve a healthy diet, but we do not yet know what the optimum diet for the brain is. The food we have eaten over the years has changed significantly and that needs to be taken into account. He noted the Government is taking bold steps to improve school meals, but said there is a case for supplementation for some nutrient deficient groups. He sees a major role for the Government or the European Union in funding research in this area, so it is not tied to companies' commercial interests.

Neil expressed scepticism that it would be possible to persuade GPs of the importance of nutrition, emphasising that different professions tend not to understand or work with each other. **Courtney** said that GPs do now recommend exercise regimes to patients who need them and she thought they could be persuaded to recommend patients see a dietician when appropriate. **Lord Rea** agreed and said the GPs in his surgery learnt more about psychotherapy as a result of working with psychotherapists attached to their surgery.

Bernard said the Dutch Medical Society seems to be more willing to recognise the importance of nutrition and he finds it odd that it is regarded as a "complementary" therapy in the UK when it is nutrients not prescription drugs that are essential for health.

Lord Rea asked **Bernard** how his team establish which of the nutrients in a multi-nutrient supplement are important and how can this be applied to dietary advice on food. **Bernard** said they begin by ensuring all nutrients are present through manipulation of the diet and then they relate measured changes in behaviour to measured changes in nutrient status. They run a range of tests to monitor the psychological and physical functioning of the volunteer. They also monitor what the volunteers eat. **Bernard** emphasised you have to relate changes in nutrient status of all the key nutrients to changes in behaviour to establish which nutrient groups are most important. If this were done with sufficient numbers you would then have the basis on which to recommend changes to dietary standards based on behaviour. Once you have these standards you could try ensure that the population consume these intakes through their diet. At present we are still trying to establish the foundations: which nutrients change behaviour; in the future scientists will seek to establish why they change behaviour.

The Countess of Mar expressed regret that it was difficult for patients with inflammatory bowel disease to obtain nutritional support from the NHS. She is aware of anecdotal evidence which demonstrates that many people with IBD benefit from supplements, but they cannot all afford to buy them and they are not made available on prescription despite the fact that this would be a cost effective method of treating IBD. **Bernard** expressed sympathy and agreed the NHS should recognise the importance of dietary interventions. He reiterated Lord Ramsbotham's view that joined up thinking was needed from Government because this is a cross-departmental issue: there is no aspect of health and behaviour that is not affected to some degree by diet.

Conclusion

Lord Rea thanked the speakers for their impressive presentations and brought the meeting to a close.