

## Nutrition and mental health

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### OBJECTIVE

- To consider the possible effects of nutritional status on cognitive function and depression.

The quality of life, especially of ageing individuals, depends profoundly on their capacity for physical mobility, mental alertness and cognitive function. Being independent and having self-esteem are strongly associated with physical and mental capacities. The way we think and feel, our mood and capacity for learning can be referred to as mental health or mental fitness; good mental fitness means having an absence of illness such as dementia, depression and anxiety, as well as an absence of stress.

### COGNITIVE IMPAIRMENT

Age-associated cognitive decline has many aspects and stages. At its earliest and least consequential, minor memory impairment may be experienced, while dementia, notably Alzheimer's disease (AD), can be personally and socially devastating. Great progress has been made in our understanding of brain changes in elderly individuals with cognitive impairment or deficits and in patients with AD. While management programs, including pharmacological agents, can alleviate suffering and facilitate care, they are often palliative rather than preventive. There is growing interest in how lifestyle measures, which include environmental contact, social

activity and physical activity, may reduce the burden of these disorders. Food and nutritional factors are likely to play a significant role in prevention and management. A number of food constituents, including known nutrients, have effects on cognitive performance, although the size of the effect of any one constituent may be small. Even the taste and smell of food, and other things like flowers and scents, may be important in maintenance of memory because of the close connection in the brain between memory and olfaction. It is particularly interesting that there is a very detailed memory for food itself ('food memory') located in the amygdala of the brain (Nishijo & Ono 1992).

Free radicals are believed to be involved in the ageing processes in the brain that lead to memory impairment. Although it is thought that dementia is not a normal part of ageing, disturbances in memory function may be linked to increased oxidative stress associated with ageing (Behl 1997). Among the vitamins that may protect against oxidative damage are fat soluble vitamins A and E, and certain water soluble vitamins such as B-6, B-12, folic acid and C. High consumption of fruit and vegetables is demonstrated to be associated with better memory performance among people aged 65 and older (Ortega et al. 1997). Experimental work has shown vitamin E protects nerve cells from amyloid  $\beta$  protein toxicity (Behl et al. 1992), considered to be important in the development of AD. In addition, treatment with  $\alpha$ -tocopherol has been reported to slow the progression of AD in patients with moderate to severe impairment (Sano et al. 1997). These findings indicate the important role played by antioxidants in brain ageing, and possibly the prevention of progressive cognitive impairment. Glutathione, a tripeptide found in food and made in the body, may be the most important antioxidant in the central and peripheral nervous systems (Cooper and Kristal 1997). While excessive ingestion of dietary aluminium is no longer believed to cause AD, zinc supplements may increase the development of AD.

Little is known about the ability of the wide range of antioxidants in food to cross the blood-brain barrier. It is postulated that oestrogen therapy can improve cognitive function or prevent AD. There are beneficial effects on cognition of hormone replacement therapy in postmenopausal women observed in a number of case-control studies, and small randomised controlled trials (Tang et al. 1996; Asthana et al. 1999). However,

other studies have not replicated these findings. Further work in this area should show whether phytoestrogen from plant foods affects cognitive function. Herbal compounds, known in traditional medicine, are of growing interest as cognitive enhancers. The very popular ginkgo biloba extract is one such product. Its mechanism of action in the central nervous system is poorly understood. But the main effects are believed to be related to its antioxidant properties, which require the synergistic action of three principal constituents of the extract, the flavonoids, the terpenoids and the organic acids (LeBars et al. 1997).

A high prevalence of AD is associated with low fish consumption, as well as with high dietary fat and total energy intakes (Grant 1997). This along with findings about the genetic regulation of fat transport in blood and brain provide interesting possibilities for the reduction of cognitive disorders. In particular, the apolipoprotein E (apoE) gene (which has 3 alleles E2, E3 and E4) is an important regulator of the production of protein of the same nomenclature, with differing abilities to transport fat and the amyloid precursor protein (APP) found to accumulate in plaques in the brains of AD sufferers. People with the apoE4 gene and proteins are at greater risk of higher triglyceride levels in the blood and APP accumulation in the brain than their apoE2 and E3 counterparts, especially if there is an apoE4 gene from each parent (ApoE4/E4). In contrast, the apoE2 allele appears to be a protective factor against AD. Thus a low fat diet may reduce the risk of AD. However, the n-3 fatty acids can actually reduce the body's (liver) formation of triglyceride-carrying molecules in the blood and, probably, reduce the apoE4 in the brain. For these and other reasons, the consumption of fish (a valuable source of n-3 fatty acids) may be favourable for brain function; n-3 fatty acids are also important in the structural components of neurones and play a role in the formation of neurotransmitters (brain chemicals transmitting information from one neurone to the next). As vitamin D and folic acid may exert an influence on brain protein synthesis, they could affect memory function in later life. One form of vitamin K (vitamin K-2 or menaquinones, produced by bacteria) appears to modulate the calcium balance in cells, and cell proliferation in tissues such as the brain. It is thought it may be important for brain function, and to help protect against AD.

### **Breakfast and cognition**

Food deprivation can affect cognition. Although when we fast the liver produces glucose, to maintain blood glucose levels, skipping breakfast may decrease the overall availability of glucose to the brain, leading to temporary impairment of cognitive performance. Breakfast consumption preferentially influences tasks which call upon memory, and a glucose drink can reverse the decline in certain memory tasks that is sometimes found when breakfast is not eaten (Benton and Parker 1998).

## **DEPRESSION**

The World Health Organization (WHO) estimates that depression is the greatest single cause of disability worldwide. Loss of appetite and loss of interest in surroundings and social relationship occur in depression. Typically anorexia is manifested by loss of interest in eating and its associated pleasure. Weight loss occurs frequently and is unintentional. A minority of depressed patients have increased appetite and weight gain. The risk of being depressed is rising rapidly in developed countries, for reasons which are unknown although many hypotheses have been proposed. It has been suggested that dietary factors could account for some of the variation in prevalence of major depression between countries. Evidence suggests that there are abnormalities of fatty acid and eicosanoid metabolism in depression.

### **Fatty acids and depression**

There are two types of essential fatty acids—the n-3, derived from dietary  $\alpha$ -linolenic acid, and the n-6, derived ultimately from dietary linoleic acid (see Chapter 13). The 20-carbon and longer-chain fatty acids of these series, with 3 and 6 double bonds, are the ones particularly involved in brain metabolism and also in immunological and inflammatory reactions. In a multinational comparison, a strong relationship has been found between apparently high fish consumption and lower prevalence of depression (Hibbeln 1998). For

example, in Japan the prevalence is 0.12%, whereas in New Zealand the rate is 5.8%; the fish consumptions are 67 and 18 kg per person per year, respectively (Figure 34.1). The most consistent observations about fatty acids and depression are low levels of both n-3 and n-6 polyunsaturated fatty acids (PUFAs) in both plasma and red blood cells; the n-3 depletion is consistently greater than the n-6 depletion leading to elevations of the n-6/n-3, arachidonic acid (AA, C20:4n-6)/eicosapentaenoic acid (EPA, C20:5n-3), and AA (C20:4n-6)/docohexaenoic acid (DHA, C22:6n-3) ratios. One particularly striking observation is that total long-chain PUFA levels in plasma are strongly positively related to cerebrospinal fluid 5-hydroxyindolactic acid, the main metabolite of serotonin, a neurotransmitter (brain chemicals transmitting information from one neurone to the next) involved in mood control. This study therefore suggests that the availability of these fatty acids may be important in modulation of mood. In the review by Drs Hibbeln and Salem from the US National Institute of Alcohol Abuse and Alcoholism, the increased consumption of saturated fat and the altered ratio of n-6 to n-3 fatty acid intake are reckoned to have increased the incidence of atherosclerosis in the 1980s and, further, the decreased n-3 essential fatty acid intake is considered to have affected the central nervous system in early development or adulthood, so increasing the vulnerability to depression (Hibbeln and Salem 1995).

It is of interest that depression is associated with a wide range of other diseases where development may in part be affected by fatty acid requirements and metabolism, including cardiovascular disease, diabetes, multiple sclerosis, cancer and osteoporosis. Chronic excessive alcohol consumption depletes DHA from the membranes of neurones, and may contribute to the secondary depression seen with alcohol excess. DHA deficiency may be associated with susceptibility to multiple sclerosis, and with the high incidence of depression in patients with multiple sclerosis (Hibbeln and Salem 1995). Some of the interaction between depression and illness may be explained by abnormalities in phospholipid and its fatty acid metabolism (Horrobin and Bennett 1999).

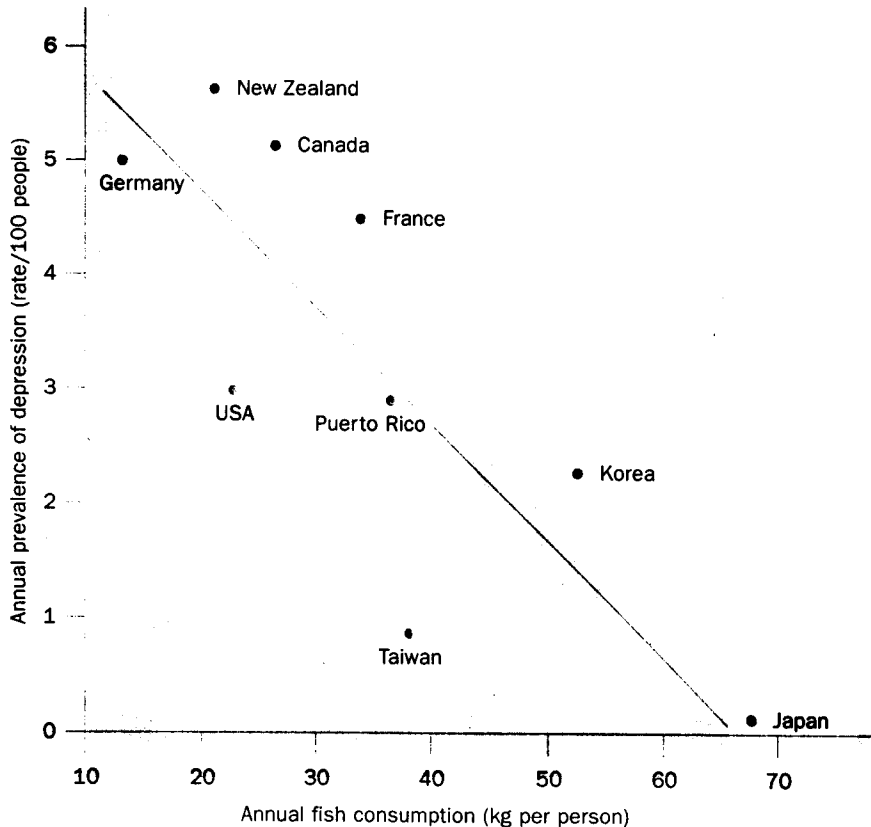


Figure 34.1 Multinational comparison of fish consumption and prevalence of depression (Hibbeln 1998)

### SUMMARY

- Excessive free radicals may lead to memory impairment in humans.
- Consumption of foods such as fish, fruit and vegetables and antioxidant nutrients could improve memory performance.
- Fatty acids from fish may be involved in mood control.

### REFERENCES

- Asthana, S., Craft, S., Baker, L. et al. Cognitive and neuroendocrine response to transdermal estrogen in postmenopausal women with Alzheimer's disease: results of a placebo-controlled, double-blind, pilot study. *Psychoendocrinology* 1999; 24:657-77.
- Behl, C. Amyloid  $\beta$ -protein toxicity and oxidative stress in Alzheimer's disease. *Cell Tissue Res* 1997; 290:471-80.
- Behl, C., Davis, J., Cole, G.M. & Schubert, D. Vitamin E protects nerve cells from amyloid- $\beta$  protein toxicity. *Biochem Biophys Res Comm* 1992; 186:944-50.
- Benton, D. & Parker, P.Y. Breakfast, blood glucose, and cognition. *Am J Clin Nutr* 1998; 67:772S-8S.
- Cooper, A.J. & Kristal, B.S. Multiple roles of glutathione in the central nervous system. *Biol Chem* 1997; 378:793-802.

- Grant, W.B. Dietary links to Alzheimer's disease. *Alz Dis Rev* 1997; 2:42-55.
- Hibbeln, J.R. Fish consumption and major depression. *Lancet* 1998; 351:1213.
- Hibbeln, J.R. & Salem, N. Jr. Dietary polyunsaturated fatty acids and depression: When cholesterol does not satisfy. *Am J Clin Nutr* 1995; 62:1123-9.
- Horrobin, D.F. & Bennett, C.N. Depression and bipolar disorder: relationships to impaired fatty acid and phospholipid metabolism and to diabetes, cardiovascular disease, immunological abnormalities, cancer, ageing and osteoporosis. Possible candidate genes. *Prostaglandins Leukot Essent Fatty Acids* 1999; 60:217-34.
- LeBars, P.L., Katz, M.M., Berman, N., Itil, T.M., Freedman, A.M. & Schatzberg, A.F. A placebo-controlled, double-blind, randomized trial of an extract of ginkgo biloba for dementia. *JAMA* 1997; 278:1327-32.
- Nishijo, H. & Ono, T. Food memory: neuronal involvement in food recognition. *Asia Pac J Clin Nutr* 1992; 1:3-12.
- Ortega, R.M., Requejo, A.M., Andres, P., Lopez-Sobaler, A.M., Quintas, M.E., Redondo, M.R., Navia, B. & Rivas, T. Dietary intake and cognitive function in a group of elderly people. *Am J Clin Nutr* 1997; 66:803-9.
- Sano, M., Ernesto, C., Thomas, R.G. & Klauber, M.R., et al. A controlled trial of selegiline, alpha-tocopherol, or both as treatment for Alzheimer's disease. The Alzheimer's Disease Cooperative Study. *NEJM* 1997; 336:1216-22.
- Savige, G., Wahlqvist, M.L., Lee, D. & Snelson B. *Agefit*. Pan Macmillan, Sydney, 2001.
- Tang, M., Jacobs, D. & Stern, Y. et al. Effect of oestrogen during menopause on risk and age at onset of Alzheimer's disease. *Lancet* 1996; 348:429-32.

# FOOD AND NUTRITION

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# Contents

Contributors

vii

## Part I HUMAN NUTRITION: THE CONCEPT AND CONTEXT

- |   |   |                               |    |
|---|---|-------------------------------|----|
| 1 | Introduction to human nutrition   | <i>Mark L. Wahlqvist</i>      | 3  |
| 2 | Evaluating the reliability of nutrition information                                     | <i>Antigone Kouris-Blazos</i> | 11 |
| 3 | Anthropological and sociological approaches to understanding food, eating and nutrition | <i>Patricia A. Crotty</i>     | 20 |

## Part II CONTEMPORARY FOOD USE AND SAFETY

- |    |  |  |     |
|----|--|--|-----|
| 4  | The food supply                                      | <i>Richard S.D. Read and Gwyn P. Jones</i>   | 37  |
| 5  | Food composition and processing                      | <i>Gwyn P. Jones</i>                         | 49  |
| 6  | Food microbiology and food poisoning                 | <i>David R. Briggs and Louise B. Lennard</i> | 70  |
| 7  | Risks, additives, contaminants and natural toxicants | <i>David R. Briggs and Louise B. Lennard</i> | 90  |
| 8  | New and emerging developments in food production     | <i>David R. Briggs and Louise B. Lennard</i> | 115 |
| 9  | Food law   | <i>David R. Briggs and Louise B. Lennard</i> | 137 |
| 10 | Contemporary food use: Food supply and food intake   | <i>Ingrid H.E. Rutishauser</i>               | 152 |

## Part III THE BIOLOGY OF FOOD COMPONENTS

- |    |                                    |                          |     |
|----|------------------------------------|--------------------------|-----|
| 11 | Food energy and energy expenditure | <i>Richard S.D. Read</i> | 171 |
| 12 | Carbohydrates                      | <i>Gwyn P. Jones</i>     | 183 |
| 13 | Fats                               | <i>Gwyn P. Jones</i>     | 199 |



14	Protein	<i>Richard S.D. Read</i>	210
15	Digestion of food	<i>Richard S.D. Read</i>	227
16	Vitamins and vitamin-like compounds	<i>Mark L. Wahlqvist and Naiyana Wattanapenpaiboon</i>	243
17	Minerals	<i>Gwyn P. Jones</i>	271
18	Water	<i>Gwyn P. Jones</i>	283

#### Part IV LIFESPAN NUTRITION

19	Pregnancy and lactation	<i>Ingrid H.E. Rutishauser</i>	291
20	Infant nutrition	<i>Ingrid H.E. Rutishauser</i>	302
21	Childhood and adolescence	<i>Ingrid H.E. Rutishauser</i>	312
22	Nutrition for activity, sport and survival	<i>Richard S.D. Read and Antigone Kouris-Blazos</i>	322
23	Requirements in maturity and ageing	<i>Mark L. Wahlqvist and Antigone Kouris-Blazos</i>	344

#### Part V FOOD AND DISEASE

24	Nutrition and bone health	<i>Mark L. Wahlqvist and Naiyana Wattanapenpaiboon</i>	367
25	Genetic individuality, diet and disease	<i>Mark L. Wahlqvist and Antigone Kouris-Blazos</i>	377
26	Overweight, obesity and eating disorders	<i>Richard S.D. Read and Antigone Kouris-Blazos</i>	384
27	Atherosclerosis and coronary heart disease	<i>Madeleine Ball</i>	415
28	Diabetes	<i>Madeleine Ball</i>	425
29	Alcohol and diseases related to alcohol	<i>Madeleine Ball</i>	435
30	Protein energy malnutrition	<i>Madeleine Ball</i>	443
31	Immune function, infection and diseases of affluence	<i>Mark L. Wahlqvist and Antigone Kouris-Blazos</i>	454
32	Nutrition and cancer	<i>Mark L. Wahlqvist and Antigone Kouris-Blazos</i>	464
33	Food sensitivities	<i>David R. Briggs and Louise B. Lennard</i>	478
34	Nutrition and mental health	<i>Naiyana Wattanapenpaiboon and Mark L. Wahlqvist</i>	487

#### Part VI FOOD, INDIVIDUALS, ENVIRONMENT AND POLICY

35	Nutrition assessment and monitoring	<i>Ingrid H.E. Rutishauser</i>	495
36	Nutritional standards of reference	<i>Ingrid H.E. Rutishauser</i>	508
37	Health promotion and nutrition	<i>Patricia A. Crotty</i>	522
38	Dietary advice and food guidance systems	<i>Antigone Kouris-Blazos</i>	532
39	Food, population and sustainable environments	<i>Richard S.D. Read</i>	558
40	Food and nutrition policies in the Asia-Pacific region: Nutrition in transition	<i>Mark L. Wahlqvist and Antigone Kouris-Blazos</i>	575
	Abbreviations		599
	Acknowledgments		601
	Index		602