Cognition and mental health: key aspects of daily function

• Cognitive skills underlie activities of daily living, e.g. learning and retaining new information, multitasking, and reasoning and problem solving, and underpin numeracy and literacy

• Cognitive function is a strong predictor of educational attainment, the principal gateway to adult socioeconomic attainment

• Nearly 10% of children aged 5-16 years have a diagnosable mental health problem

• Cognition and mental health are inter-associated across the life course, and have common antecedents
The long reach of childhood cognition

Childhood cognition correlates strongly with early adult cognition...

Plassman et al. Journal of Neurology 1995

...midlife cognition


...and later life cognition

Deary et al. Intelligence 2000
ESTIMATED GROWTH OF DEMENTIA

The number of people with dementia will roughly double every 20 years, with the biggest increases in developing countries.
Figure 1  Cost of dementia compared to company revenue

US$ billions

Dementia  Wal-Mart  Exxon Mobil

600  400  200

25  20  15  10  5

Dementia  Cancer  Heart disease  Stroke

Total costs, comprising direct and indirect costs

Comparing Costs
In the United Kingdom, the economic impact of dementias dwarfs the costs of other diseases.

Comparing Investment
In the United Kingdom, annual government and charity spend on dementia research is 12 times lower than on cancer research.

For every person in the UK with dementia just £61 is spent on research, compared to £295 for every person with cancer.
Tracking of mental health

- Emotional problems show life course continuity (Rutter, Kim-Cohen & Maughan 2006)

- Risk is transmitted across generations (Weissman et al. 2006)

- Positive wellbeing also shows life course continuity (Richards & Huppert 2011)
Depression

The leading cause of years of health lost to disease in middle and high-income countries

Persistent, and often disabling, with considerable social impact on families and the workplace

Treatable; identifiable risk and protective factors

Approximately half are not diagnosed by the GP, and those who are diagnosed are often inadequately treated

Economic costs can be huge; easily the biggest is on productivity at work, which is many times larger than estimated costs to the NHS
The cost of conduct problems: likelihood of:

- No educational qualifications
- Chronic economic inactivity
- Lower earnings
- Unstable intimate partnerships
- Teenage parenthood
- Arrest and court conviction

Richards & Abbott 2009
Maternal diet during pregnancy: processes

- Transmission of nutrients to foetus via the placenta
- Long-chain fatty acids influence the duration of pregnancy, which in turn influences outcomes
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- Long-chain fatty acids influence the duration of pregnancy, which in turn influences outcomes

- Maternal nutritional deficits typically co-occur with other factors that can impair foetal development, such as teratogenic agents and psychological stress

- Maternal nutrition can influence maternal mental health (e.g. synthesis of serotonin is influenced by foods containing tryptophan)
Maternal diet during pregnancy: long-chain fatty acids

• Foetal requirement for DHA during compromised maternal supply can to some extent be met through conservation, accessing from reserves, and synthesis from precursor

• However, a consensus European Commission panel recommends that pregnant and lactating women should achieve an intake equivalent to 2 portions of fish per week

• Consumption of seafood during pregnancy is associated with higher verbal IQ and better social development in ALSPAC (Hibbeln et al. 2007)

• Pregnancy is associated with reduction in PUFA status of the mother herself (maternal depletion syndrome)
Maternal diet during pregnancy: other nutrients

- B\textsubscript{12} deficiency can lead to a range of neurological deficits that affect cognition (though respond well to supplementation)

- Choline is necessary for hippocampal development and can reduce the consequences of prenatal stress

- Inconclusive evidence for vitamin D

- Iodine deficiency is the most common preventable cause of learning disability

- Iron deficiency anaemia may lead to behavioural disturbance

- Low maternal intake of zinc is associated with impaired attention and decreased motor function in infants
NEUROMOTOR DEVELOPMENT


Colman et al. Biol Psychiat 2007
Breast feeding

Breast milk contains numerous macro and micronutrients:

- Fats (triglycerides, lipids)
- Long-chain fatty acids
- Carbohydrates (e.g. lactose bifidus factor)
- Proteins (e.g. casein, alpha-lactalbumin)
- Defence mechanisms (antibody, lymphocyte, anti-inflammatory, antimicrobial)
- Digestive enzymes (e.g. lipase)
- Range of hormones, peptides and growth factors
Breast feeding and mental development

• A meta-analysis of 16 observational studies (Anderson et al. 1999) suggests a modest benefit to childhood IQ, with a dose-response effect for duration, and more benefit in low birth weight infants.

• Effects observed when milk delivered by nasal tube, and in randomised studies (but poor results for enriched formula).

• Generally assumed to be due to long-chain fatty acids, particularly AA and DHA, although there may be benefits secondary to other health-protecting ingredients.

• Also thought to regulate emotion and conduct (oxytocin and prolactin are antagonistic to the HPA axis), although evidence is mixed when maternal mental health is controlled.
Breast feeding and mental development

However:

- Long-term effects are modest, or only seen in those of lower birth weight

- Associations are confounded by maternal cognitive ability (Der et al. 2006)

- The ‘weanling’s dilemma’ suggests that exclusive breast feeding for the first 6 months may not fully meet the nutritional requirements of the infant (e.g. iron and zinc require an exogenous source after 6 months)
Post-weaning diet

- Infant diet high in fruit, vegetables and home-prepared foods associated with higher IQ after adjusting for a wide range of confounders, including maternal cognitive ability (Gale et al. 2009)

- Iron uptake into the brain continues throughout life, and is essential for the synthesis of major catecholamines; symptoms of anaemia can impair cognitive function; modest benefit of supplementation to mental and motor development

- Inconclusive evidence that tartrazine (food dye) and sodium benzoate (preservative) lead to behaviour problems
Conclusion

While received wisdom suggests that intakes of key micronutrients is likely to be adequate in a balanced diet in middle and high income countries, *in no instance have psychological or behavioural indices been the measure of adequacy.*

Yet psychological symptoms are often the first manifestation of micronutrient deficiencies, and can be improved by supplementation ... This should not be surprising given that the brain is the most complex and metabolically active organ in the body.