



# The benefits of eating oily fish

Research from **TEAGASC** and collaborators points to the need for a rethink of current recommendations on fish consumption in pregnancy.

Dietary polyunsaturated fatty acids (PUFAs) are associated with reduction in risk of chronic diseases such as cardiovascular disease (CVD), Alzheimer's disease (AD) and inflammatory bowel disease (IBD). PUFAs can be classed based on the location of the first double bond in the chain, with omega-3 (n-3) and omega-6 (n-6) being the most important for health. Humans and higher animals are unable to synthesise some of the omega fatty acids (both n-6 and n-3), referred to as essential fatty acids, and therefore these fatty acids must be obtained from our diet in order to maintain optimal health.

The main dietary sources of n-6 PUFAs are plant oils such as sunflower, safflower and corn oils. Cereals, eggs, poultry and wholegrain breads are other dietary sources, while oily fish (such as mackerel, salmon, sardines, trout, and herring) and certain nuts and seeds are rich sources of n-3 fatty acids. As a result of the large-scale marketing of cooking oils and margarines rich in n-6, typical intakes of n-6 fatty acids are now in excess of dietary requirements.

The ratio of n-6 to n-3 is considered important to health, with optimal dietary intakes of n-6:n-3 believed to be in the region of around 1-4:1; however, recent dietary shifts in Western countries show a higher ratio of consumption of n-6:n-3 of 15-16:1. This shift in the ratio between these two fatty acids in Western diets is considered to be a major dietary problem. In parallel to these disorders in metabolism, there are coinciding increases in the incidence of diseases that involve inflammatory processes such as CVD, IBD, obesity, rheumatoid arthritis and cancer. Neurodegenerative and psychiatric illnesses such as AD and depression are other examples that have been linked to a high intake of n-6 PUFAs in the diet.

We have recently conducted a human intervention study where healthy women were given one or two portions of fish to see if increasing n-3 status can affect our gut bacteria as seen in our mouse trial.

## PUFAs and pregnancy

As PUFAs are required to produce every cell in the human body, they are particularly important during pregnancy for the development of the foetus. Our recent study published in the journal *Microbiome* has demonstrated that n-3 PUFAs may also be very important during pregnancy and breastfeeding, and that the gut bacteria may be a key mediator of the health benefits of n-3 PUFAs during early development. This work was a collaboration with Prof. Kang at Harvard University, USA, and funded by The Fulbright Commission of Ireland and Science Foundation Ireland (SFI). A unique transgenic mouse model that has an inserted gene, which can convert dietary n-6 into n-3 PUFAs, was used. These transgenic mice and their wild type counterparts (mice unable to convert n-6 to n-3) were fed a high-fat diet rich in n-6 PUFAs during pregnancy and the weaning period.

The research shows that mice born from high n-3 PUFA status mothers gained less weight when switched to a high-fat diet. Interestingly, this decrease in weight gain only occurred in male mice; the mother's fats had no effect on weight in female mice pups. Furthermore, n-3 PUFA status was found to promote gut health of their offspring. Mothers that were deficient in n-3 PUFAs during pregnancy and breastfeeding produced young with guts that were more 'leaky', and which led to inflammation. These young mice also had more of certain unhealthy bacteria in their intestines, which may have contributed to their weight gain. However, if young mice were breastfed by a mother with high n-3 PUFA status, their guts were healthier and had more healthy bacteria. Importantly, the effect of the mother's fatty acid status on her babies' gut health continued into adulthood. This study, although in animals, suggests that women should be consuming diets with a more healthy n-3:n-6 ratio during pregnancy and breastfeeding in order to promote their infant's health.

### Addressing controversies

Current nutritional guidelines recommend that we should be consuming at least two portions of fish a week, including at least one portion of oily fish; however, there is considerable controversy about consuming oily fish during pregnancy owing to concerns about methyl-mercury (MeHg) exposure and neurodevelopmental impairment of the child. Nutritional guidance in the EU, USA and elsewhere has been to limit the consumption of oily fish to avoid MeHg exposure. This advice is based on evidence from the Faroe Islands where mothers who had higher exposures to MeHg through pilot whale consumption had children who did less well in some developmental tests.

In contrast, research carried out by our collaborative partners at the Nutrition Innovation Centre for Food and Health (NICHE) at Ulster University, Coleraine, together with partners in the University of Rochester, New York, and the Ministry of Health in the Republic of Seychelles, suggests that the benefits of eating oily fish during pregnancy outweigh the risks of MeHg exposure. In three large mother-child cohorts followed in the Seychelles since the 1980s no adverse associations were found between MeHg exposure during pregnancy and later development. Indeed, any associations found were in the opposite direction, suggesting that mothers who had greater MeHg exposures and were therefore consuming more fish had children who did better in a range of developmental tests than children from mothers who consumed less fish during pregnancy. We have recently conducted a human intervention study where healthy women were given one or two portions of fish to see if increasing n-3 status can affect our gut bacteria as seen in our mouse trial.

### Conclusions

- Dietary n-3 PUFAs are important for our health and may protect against inflammatory diseases. Increasing n-3 PUFA intake during pregnancy and breastfeeding is beneficial for both mother and child.

- Oily fish is rich in n-3 PUFAs and the current advice about limiting oily fish during pregnancy should be reviewed.
- The health benefits of n-3 may, in part, be mediated by the bacteria living in our guts.
- The gut microbiota represents a target for promoting health through consuming a more healthy diet.

### References

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