Increasing fish consumption in women of child-bearing age: an evaluation of risks and benefits

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List of Abbreviations

AA	Arachidonic acid
ABS	Australian Bureau of Statistics
AHP	Allied Health Professional
AHRQ	Agency for Healthcare Research and Quality
AI	Adequate intakes
ALA	Alpha-linolenic acid
ALSPAC	Avon Longitudinal Study of Parents and Children
ALSWH	Australian Longitudinal Study on Women's Health
AMDR	Acceptable macronutrient distribution ranges
AQ	AsureQuality Limited
BDI	Beck Depression Inventory
BMI	Body mass index
BSID	Bayley Scales of Infant Development-Mental Development
CLAMSDQ	Clinical Linguistic and Auditory Milestone Scale Developmental Quotients
CRP	C-reactive protein
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CURF	Confidentialised Unit Record Files
CVFAS	Cold vapour atomic fluorescence spectroscopy
DHA	Docosahexaenoic acid
DOMInO	DHA to Optimize Mother Infant Outcome
DNBC	Danish National Birth Cohort
DPA	Docosapentaenoic acid
DQES	Dietary Questionnaire for Epidemiological Studies
EAR	Estimated average requirement
EEG	Electroencephalogram
EPA	Eicosapentaenoic acid
EPC	Evidence-based Practice Center

EPDS	Edinburgh Postnatal Depression Scale
ERG	Electroretinogram
FRDC	Fisheries Research & Development Corporation
FSANZ	Food Standards Australia New Zealand
GEE	Generalised estimating equations
HDL	High-density lipoprotein
HPLC	High-performance liquid chromatography
ICER	Incremental cost effectiveness ratio
IgE	Immunoglobulin E
IOM	The Institute of Medicine of the National Academies of Science
IUGR	Intrauterine growth retardation
LCn3PUFA	Long chain n-3 polyunsaturated fatty acids
LOR	Limit of Reporting
MADRS	Montgomery-Asberg Depression Rating Scale
MAR	Minimal angle of resolution
MDI	Mental Developmental Index
MeHg	Methyl mercury
NATA	National Association of Testing Authorities
NHANES	National Health and Nutrition Examination Survey
NHMRC	National Health and Medical Research Council
NMI	National Measurement Institute
NNS	National Nutrition Survey
NRV	Nutrient reference values
NUHEAL	Nutraceuticals for a Healthier Life
PAL	Physical activity level
PCR	Polymerase chain reaction
PDI	Psychomotor Development Index
PIH	Pregnancy-induced hypertension

PUFA	Polyunsaturated fatty acids
RCT	Randomised controlled trials
RDI	Recommended dietary intake
RMIT	Royal Melbourne Institute of Technology
RPD	Relative percentage difference
SARDI	South Australian Research and Development Institute
SCORAD	SCORing Atopic Dermatitis
SDT	Suggested dietary target
SiPS	Salmon in Pregnancy Study
SLS	Sodium lauryl sulphate
SNP	Single nucleotide polymorphisms
SPME	Solid phase microextraction
THg	Total mercury
UL	Upper level of intake
VEP	Visual evoked potential
WHO	World Health Organization

Summary

Epidemiological studies have consistently demonstrated positive association of infant neurodevelopment with maternal fish consumption, mostly attributed to the abundance of long chain n-3 polyunsaturated fatty acids (LCn3PUFA) in fish. However, fish consumption by Australian women is overall less than optimal. Secondary analysis of nationally conducted surveys [1995 National Nutrition Survey and the Australian Longitudinal Study on Women's Health (ALSWH) in 2003 and 2009] demonstrated that less than half of Australian women of child-bearing age would consume fish at least twice a week as recommended by the Australian Dietary Guidelines. Of concern was the even lower fish intake in women who were pregnant or had recently given birth when compared with other women in the ALSWH surveys. This observation suggests that women may consume less fish whilst pregnant for fear of potential contaminants that might be present in fish.

A dietary modelling exercise based on the food consumption pattern from the Australian Dietary Guidelines confirms that one would need to consume three serves of oily or high LCn3PUFA fish per week to meet the suggested dietary target of 430 mg of LCn3PUFA for women as recommended by the National Health and Medical Research Council.

In order to ascertain the levels of LCn3PUFA and other nutrients present in Australian fish/fish products, several commonly consumed fish/fish products selected for use in the ensuing randomised trial were analysed following standardised procedure. Mercury contents of these fish study foods were also tested and found to be relatively low (range: 1.1 µg–7.0 µg/100 g).

To assess the acceptability of a diet that included more fish and its effects on biological parameters, a single-blinded randomised controlled eight-week trial was conducted in healthy women aged 18–50 years who normally consumed no more than one oily fish meal per week. The higher fish diet included four serves per week of a variety of fresh and convenience fish products (including canned and frozen, oily and non-oily) and were provided to the participants. The control group was asked to maintain their usual lower fish/higher meat diet and participants were provided with four serves of beef, chicken or deli-meat per week. After eight weeks,

significant increases in mean eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA) and methyl mercury levels were observed in the intervention group when compared to the control group. Although blood mercury level did rise with increased fish intake, it was still at a level accepted as safe. The median acceptability score for both diets was the same suggesting no difference in diet acceptance.

A cost-effectiveness study conducted post-trial demonstrated that including fish in a diet is an economical means to obtain LCn3PUFA. To obtain equal amount of DHA, it would have cost sixty times more if consuming the meat study food compared to the fish study food.

In conclusion, it has been demonstrated that consuming a variety of fish and fish products several times a week is an acceptable and cost-effective means of improving LCn3PUFA status without causing detrimental increases in mercury levels, provided low-mercury containing fish are consumed. Women of child-bearing age are advised to consume high-LCn3PUFA but low-mercury containing fish as part of a healthy diet.

Declaration

I certify that this thesis does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.

Lily L H Chan

Presentations

Poster presentation

Chan, L, Grieger, JA, Miller, Cobiac, L 2010, 'Simulation of fish intake in women of child-bearing age', poster presented to the 2010 Annual Scientific Meeting of the Nutrition Society of Australia, Perth, Australia, 30 November–3 December.

Oral presentation

Chan, L, Grieger, JA, Cobiac, L 2010, 'Fish and seafood intake in Australian women of child-bearing age', abstract presented to the International Seafood & Health Conference, Melbourne, Australia, 8–10 November.

Chan, L, Miller, M, Thompson, C, Midgley, J, Cobiac, L 2011, 'Assessment of the effects and acceptability of a higher fish diet in women of child-bearing age' abstract presented to the 35th Annual Scientific Meeting of the Nutrition Society of Australia and New Zealand, Queenstown, New Zealand, 30 November–2 December.

Oral presentation at the Flinders Clinical and Molecular Medicine Cluster Seminar Series, Flinders University, 25 August 2010 and 3 August 2011.

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