Nutrition in pregnancy: The balancing act

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Pregnant women are exposed to a large number of confusing messages on weight gain, nutrient supplements and food avoidance. This article presents a summary of the evidence so that the risks and benefits of nutrition information can be weighed up. In most cases the evidence is not as clear as guidelines and recommendations present. Differences of scientific opinion usually reflect legitimate debate over data quantity, quality and interpretation, and advances in knowledge lead to changes in practice over time. Evidence-based guidelines typically have long periods between release and review. To date there are known risks and benefits associated with gaining too much or not enough weight during pregnancy, taking nutrient supplements, consuming foods at-risk of contamination with listeria including fish and seafood, which is also a source of mercury. The benefits from no versus very low alcohol during pregnancy are debatable but while there is uncertainty, not drinking is the safest option.

How much weight should a woman gain during pregnancy? The answer to this question has changed over time. In the two decades between the release (1990) and review (2009) of the Institute of Medicine's guidelines, more research became available, population levels of overweight and obesity rose dramatically around the world, and maternal age increased (Institute of Medicine (IOM) and National Research Council (NRC) 2009a). Birth weight is now used as a predictor of both short and long term morbidity and mortality for the offspring (Risnes et al., 2011; Yu et al., 2011). Weight gain during pregnancy is second only to length of gestation as the strongest predictor of birth weight (Johansson et al., 2007). The physiological weight gains of pregnancy have been estimated as totaling 12.5 kg, which includes a 3.3 kg increase in maternal fat stores to support lactation (Hytten, 1991).

The 2009 Institute of Medicine guidelines for weight gain during pregnancy reflect new knowledge about the importance of weight status before conception, particularly at the higher end of the weight spectrum (Institute of Medicine (IOM) and National Research Council (NRC) 2009b). Pre-pregnancy body mass index (BMI = weight in kg / height in m2) is used to tailor weight gain advice to different women, with recognition that good obstetric and postnatal outcomes are achieved within a range of weight gains. Women who are overweight and obese at the beginning of pregnancy are more likely to have gestational diabetes, pre-eclampsia, and require a caesarean section (Doherty et al., 2006). The guidelines presented in Table 1 were developed for use among American women, but are applicable to

women in other developed countries. In Australia, it is recommended that women are weighed and BMI calculated at their first antenatal clinic visit, with information on appropriate weight gain provided (Australian Health Ministers' Advisory Council, 2012). However, repeated weighing during pregnancy is not currently recommended unless it is likely to influence clinical management (Australian Health Ministers' Advisory Council, 2012).

TABLE 1:
Institute of Medicine's (2009) recommended weight gain during pregnancy by pre-pregnancy body mass index (BMI)

Pre-pregnancy BMI		Institute of Medicine 2009	
	kg/m2	Pounds	Kilograms
Underweight	<18.5	28-40	12.5-18
Normal range	18.5-24.9	25-35	11.5-16
Overweight	25-29.9	15-25	7-11.5
Obese	≥30	11-20	5-9

Weight gain is a crude indicator of total energy intake during pregnancy, not discounting the important role of basal metabolic rate and energy expenditure. As a simple measure, weight gain provides useful information on whether a woman is eating too much or too little to support optimal fetal growth. However, weight gain cannot be used to assess the micronutrient adequacy of the maternal diet.

NUTRIENT SUPPLEMENTS

We now understand that nutrients from food and supplements play important roles in the biological pathways for programming later health and disease propensity. Nutritional genomics is an area of science dedicated to understanding the relationships between nutrition, health and the human genome. There are examples throughout the literature where supplements are used as therapeutic agents for the prevention or treatment of disease (Miller et al., 2014) but equally, excess nutrient intakes can result in adverse outcomes (Lee et al., 2012). However, there are graphically different standards in the marketing and regulation of nutrient supplements compared to drugs, which may require review in the future.

In Australia, multivitamins and mineral supplements 'specially formulated' for pregnancy are heavily marketed to women and health professionals. At a population level, the nutrient intakes of women during pregnancy are generally adequate to meet the demands during pregnancy (Hure et al., 2009). Iron and folate are the nutrients least likely to be met through diet alone (Hure et al., 2009) and Australians have been classed as mildly iodine deficient according to the World Health Organization (WHO). Vitamin D is a fat-soluble micronutrient that has attracted much attention throughout the scientific literature in recent times. In Australia, the major source (90%) of vitamin D is through sun exposure, with the remaining contribution made by only a few foods: fish-liver oils, fatty fish, mushrooms, egg yolks, and liver. Although there is evidence vitamin D intakes from food may be inadequate (Blumfield et al., 2013) there is also no evidence to suggest that supplementation during pregnancy improves clinical outcomes (De-Regil et al., 2012). Pregnant women with limited sun exposure, dark skin, a BMI of 30 kg/m2 or more, and those who wear veils should be screened for deficiency and treated as necessary (Australian Health Ministers' Advisory Council, 2012).

> Women taking supplements before or around the time of conception have almost a 40% increased odds of a multiple pregnancy.

Many of the large trials showing benefit from nutrient supplementation have been conducted in developing countries where under-nutrition is common (Haider & Bhutta, 2012). Nutrient supplements should be used to correct nutrient deficiencies (for example, if iron deficient) or when there are known benefits which are thought to outweigh any risks (folic acid and iodine). It is important to understand that there is potential for harm as well as benefit. Hence it is not appropriate to recommend that all women take a broad-spectrum daily multivitamin before or during pregnancy. Women taking supplements before or around the time of conception have almost a 40% increased odds of having a multiple pregnancy (Rumbold et al., 2011) which carries greater risks for both the mother and child. In older non-pregnant women, several commonly used dietary vitamin and mineral supplements have been associated with increased total mortality risk (Mursu et al., 2011). This association is strongest with supplemental iron (Mursu et al., 2011). Women who are identified during antenatal care as having poor diets should be referred to a dietitian who can make a complete nutritional assessment and provide tailored advice.

FOLIC ACID

The strongest evidence of clinical benefit for any nutrient supplementation for pregnancy is for folic acid. Folic acid has been repeatedly shown to reduce the occurrence of neural tube defects by around 70% when taken prior to conception and during the first trimester (De-Regil et al., 2010; Lumley et al., 2001). Physiologically, the neural tube has closed by six completed weeks' gestation. However, due to possible dating inaccuracies, the recommendation for folic acid supplementation is to continue supplementing throughout the first trimester. There is an increased risk of neural

tube defects in women with a previously affected pregnancy, obesity, diabetes, and in those taking anticonvulsant medication (The Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG) 2013).

RECOMMENDED SUPPLEMENT OF FOLIC ACID: GRADE A EVIDENCE

500 µg per day 12 weeks before conception and throughout the first 12 weeks of pregnancy (Australian Health Ministers' Advisory Council, 2012)

Women at higher risk are advised to take a 5 mg per day folic acid supplement compared to the general recommendation of 500 µg per day (The Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG) 2013).

MANDATORY FORTIFICATION

Due to the high rates of unplanned pregnancies (estimated to be around 50% in Australia) and low uptakes of recommended supplementation, many governments around the world have introduced some degree of mandatory fortification. Voluntary fortification of foods with folic acid was introduced in Australia in 1995. Mandatory fortification with folic acid was then implemented from September, 2009. In Australia, wheat flour used for bread-making must be fortified with folic acid, within the prescribed range of 200 to 300 µg per 100 g of flour, unless it is represented as organic. At a population level, the overall prevalence of neural tube defects has continued to decline by 2.2 neural tube defects per 100,000 births per year, from 1998 to 2008 (Macaldowie & Hilder, 2011).

IODINE

Iodine plays a critical role in neuropsychological development of the fetus during pregnancy and in the first two years of life. In high income countries, severe iodine deficiency, which results in goiter, hypothyroidism and cretinism, is uncommon. The effects of mild to moderate iodine deficiency are less clear and are likely to cause more subtle cognitive and neurological impairments (Zimmermann, 2009).

In 2009, the National Health and Medical Research Council of Australia released a recommendation for daily iodine supplementation for women preconception, during pregnancy and throughout lactation (National Health and Medical Research Council, 2010). The recommended 150 µg per day was determined using data on average iodine intakes after mandatory bread fortification, based on knowledge that the Australian population is now classified by the WHO as mildly iodine deficient (National Health and Medical Research Council, 2010). Kelp (seaweed) supplements or kelp-based products are not recommended because they contain varying levels of iodine (Teas et al., 2004) and may be contaminated with heavy metals such as mercury (National Health and Medical Research Council, 2010).

RECOMMENDED SUPPLEMENTATION: CONSENSUS BASED RECOMMENDATION

150 µg per day during pregnancy and lactation (Australian Health Ministers' Advisory Council, 2012). The National Health and Medical Research Council recommend those who are planning a pregnancy start taking iodine. However, with Australia's mandatory fortification policy, population intakes are now thought to be adequate and the National Antenatal Care Guidelines recommend supplementation commence during pregnancy (Australian Health Ministers' Advisory Council, 2012).

In Australia, salt used in bread-making is now required to be fortified with iodine, except when bread is represented as organic (National Health and Medical Research Council, 2010).

IRON

Since 2000, there have been nine or more Cochrane Systematic Reviews on iron supplementation during pregnancy (Pena-Rosas et al., 2012a; Pena-Rosas et al., 2012b; Pena-Rosas and Viteri, 2009; Mahomed, 2006a; Mahomed, 2006b; Pena-Rosas and Viteri, 2006; Cuervo & Mahomed, 2001; Mahomed, 2000a; Mahomed, 2000b). Over this time, the evidence has gone from showing iron to be effective in reducing iron deficiency and iron-deficiency anaemia based on haematological indices, to demonstrating almost a 20% reduction in low birth weight (Pena-Rosas et al., 2012a). With iron supplementation, side effects are common (i.e. diarrhoea, vomiting and high haemoglobin levels) particularly at high doses (60 mg per day).

In Australia, routine iron supplementation is not currently recommended for every pregnancy (The Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG) 2013). Wide disparities exist in both preterm birth and growth restriction among different population groups throughout the United States and Australia. Low-income and African-American women, for example, have twice the preterm birth rate and higher rates of growth restriction compared to most other women (Goldenberg & Culhane, 2007). This figure is echoed amongst Australian Aboriginal women who have more than twice the rate of low birth weight compared to non-Indigenous Australian women (Li et al., 2013).

ALCOHOL DURING PREGNANCY

In 2009, the Australian alcohol guidelines changed from low to no alcohol intake during pregnancy. The message to promote is that there is no known safe limit (National Health and Medical Research Council, 2009). Internationally, the recommendations for alcohol during pregnancy are slightly varied in their wording but generally reflect the same sentiment: not drinking is the safest option. The United Kingdom recognises that small amounts of alcohol during pregnancy (no more than 8 to 16 grams of alcohol, no more than once or twice a week) have not been shown

to be harmful (International Center for Alcohol Policies (ICAP) 2014). This takes perhaps a more pragmatic approach to matching the evidence for drinking during pregnancy and the behaviours of women (Anderson et al., 2012) recommending low levels of drinking if at all. Fetal alcohol spectrum disorder is an outcome of higher intakes of alcohol during pregnancy. In theory, it is entirely avoidable. However, the circumstances leading a woman to abuse alcohol during pregnancy likely require broader consideration of the social determinants of health.

EVIDENCE-BASED GUIDELINE: ALCOHOL

Based on systematic reviews of the literature and prospective cohort studies, there is no known safe limit of alcohol during pregnancy (National Health and Medical Research Council, 2009).

LISTERIA

The immune system is suppressed during pregnancy so that the mother does not reject the fetus. As a result, pregnant women are more susceptible to infection. Listeriosis is an infection caused by the bacteria Listeria monocytogenes and is contracted by eating contaminated food. In Australia, the incidence of listeriosis is very low, with about 45 case-notifications made nationally each year (Dalton et al., 2011). Between five and seven of those cases occur in pregnant women and their offspring, with a fetal fatality rate of about 20% (Dalton et al., 2011). In an effort to prevent infection during pregnancy, government health authorities issue advice to avoid foods which have a higher risk of Listeria contamination, including soft cheeses, deli meats and pre-prepared salads. A recent national study on the dietary intakes of Australian childbearing women examined foods at-risk of Listeria contamination. Pezdirc and colleagues (2012) showed that avoiding foods identified as higher risk of Listeria contamination was associated with poorer diet quality and nutrient intakes. However, the women with the highest intakes of at-risk foods self-reported almost 20% more miscarriages after adjustment for smoking, maternal age, parity, alcohol use and BMI, compared to those with the lowest intakes of at-risk foods (Pezdirc et al., 2012).

Dalton and colleagues (2011) recently conducted a case-control study specifically investigating predictors of listeriosis, including 19 maternal-fetal cases. They showed that living in a household where a language other than English was spoken was the main risk factor (odds ratio 11.3, 95% confidence interval 1.5–undefined) in maternal-fetal cases and none of the 38 risky foods were predictors, although their analyses may have been underpowered because of the small sample (Dalton et al., 2011). The strength of the evidence should also be considered when advising women about what to eat during pregnancy. In the case of the Listeria guidelines, the evidence is graded level D, meaning the body of evidence is weak and recommendations must be applied with caution (Grade A is applied where the body of evidence can be trusted to guide practice, as in the case of folic acid supplementation).

MERCURY

Another good example of a confusing nutrition message is about consuming fish while pregnant. Mercury is a toxic metal found in certain fish and can cause damage to both adult and fetal nervous systems. Mercury levels during pregnancy have been associated with rates of miscarriage, infertility, elevated childhood blood pressure, and subtle cognitive deficits in language, attention, and memory (Golding et al., 2013). On the other hand, fish and

seafood can be an excellent source of protein, minerals, vitamin B12 and iodine, in addition to omega-3 fatty acids which are also important for the development of the central nervous systems before and after birth.

Current recommendations in Australia suggest two to three serves per week of low-mercury fish and seafood (NSW Food Authority, 2013). Higher mercury options in Australia include Catfish, Orange Roughy (Deep Sea Perch), Shark (Flake) and Billfish (Swordfish, Marlin), and should be limited to once a week or once a fortnight, consuming no other fish during that period (NSW Food Authority, 2013).

Herbal teas are a dietary predictor of total blood mercury.

The recommendation for limiting fish and seafood to reduce mercury exposure during pregnancy is a consensus based recommendation and more evidence will, no doubt, result in a revision of the guidelines in years to come. In a recent sample of 4484 pregnant women from the Avon Longitudinal Study of Parents and Children (ALSPAC) birth cohort in the United Kingdom, dietary mercury exposure from seafood was found to contribute less than half of the overall mercury intake from dietary sources (Golding et al., 2013). Herbal teas were an unexpected dietary pre¬dictor of total blood mercury. However, overall a large proportion of the variance in blood mercury levels was not associated with any dietary variable. This study suggests that the assumption of reducing or limiting fish consumption to reduce mercury exposure may be a less successful strategy than previously thought. Further work is needed to provide clearer guidance.

CONCLUSION

Is has been said that the only certainty in life is change. This article has summarised the evidence and recommendations that are available to health professionals and pregnant women today, recognising where significant changes in knowledge and practice have occurred within a relatively short timeframe. In highlighting these changes and the current grading of evidence we acknowledge that the information we have should inform clinical practice but there are circumstances where focussing too heavily on the public health guidelines is inappropriate. For example, even the high-risk Listeria foods are low-risk and there is the potential for compromising nutritional quality through promoting food avoidance. Health professionals should consider maternal nutrition during pregnancy as a balancing act. As more evidence becomes available it should become clearer where advances can be made without unexpectedly causing harm.

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