Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive

INSTITUTE OF OBSTETRICIANS & GYNAECOLOGISTS
ROYAL COLLEGE OF PHYSICIANS OF IRELAND

CLINICAL PRACTICE GUIDELINE

Nutrition During Pregnancy

Institute of Obstetricians and Gynaecologists,
Royal College of Physicians of Ireland
and
Directorate of Clinical Strategy and Programmes,
Health Service Executive

(Endorsements pending)

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Summary of Recommendations for Nutrition in Pregnancy

1. All women who may possibly become pregnant within the next three months, whether intentionally or not, are advised to take **oral FA (FA) 400 micrograms daily** to prevent Neural Tube Defects (NTDS); higher does are required preconception & in the first trimester for those with a higher risk of neural tube defects (NTDs) e.g. history of NTDs, obesity or pre-existing diabetes mellitus.
2. Pregnant women and women planning pregnancy should be encouraged first and foremost to **eat a healthy, balanced diet** incorporating foods based on the national Food Pyramid – sources of iron, calcium, vitamin D and long chain omega-3 polyunsaturated fatty acids are particularly important.
3. **Additional vitamin D_3 10µg is** recommended daily during pregnancy to support intake. A pregnancy multivitamin is a simple way to achieve this.
4. **Food safety** is enhanced by good food hygiene and avoiding foods or food supplements which may be teratogenic or harmful to development.
5. All women booking for antenatal care should have their **Body Mass Index calculated accurately.**
6. Ideally women who are underweight, overweight or obese should be seen by a dietitian for **pre-pregnancy dietary counselling in the community to optimise weight prior to conception** and therefore reduce associated risks during pregnancy.

Separate guidelines are available for obesity & pregnancy, diabetes in pregnancy and for nausea, vomiting and hyperemesis gravidarum.

1.0 Key Guideline Recommendations

1.1 Gestational Weight Gain

- All pregnant women must have an accurate weight, height and body mass index (BMI) measured and recorded at the first antenatal visit. Use BMI to screen women at increased risk for weight-related co-morbidities.
- Pregnancy is a time when women are keen to receive more information about healthy lifestyle interventions and are motivated to make positive choices. Antenatal appointments offer an opportunity to utilise the brief intervention model outlined in the Making Every Contact Count (MECC) Framework.
- Women who are identified as underweight (BMI <18.5 kg/m^2) at booking require monitoring for weight gain and referral to a dietitian for assessment.
- Encourage women to achieve a healthy weight before conception to prevent associated complications. Advise postnatal weight loss in overweight and obese women and, where available, refer to a community dietitian.

1.2 Macronutrients

1.2.1 Energy

- Advise women that their dietary energy requirements in the beginning of pregnancy increase only marginally from pre-pregnancy levels. Encourage women to focus on eating well and not only on eating more.
- Energy requirements vary depending on a woman's age, BMI, number of fetuses and activity level. Caloric intake should be individualised based on these factors.

1.2.2 Carbohydrate and fibre

- An RDA of 175g per day is set, based on adequate blood glucose for utilization by the maternal and the fetal brain. This can be met with 3 servings of fruit, 2 servings of vegetables, 3 servings of milk or yoghurt and 3 servings of whole grains.
- Women are encouraged to eat a variety of whole grains, fruit, vegetables, legumes (starchy beans, lentils and pulses), nuts and seeds to meet fibre requirements.

1.2.3 Protein

- Adequate dietary protein intake throughout pregnancy is essential to ensure normal growth and development of the fetus.
- Two servings of protein foods per day in the first and second trimester and three servings in the third trimester will meet these requirements.
- For women who are undernourished or underweight, a balanced protein/energy nutrient supplement may be useful in pregnancy, but only under medical and dietetic supervision.

1.2.4 Fat

- National healthy eating guidelines are applicable to pregnant women in relation to fat intake.
- Pregnant women should be advised to minimise or avoid dietary intake of trans- fatty acids during pregnancy by avoiding fried foods, bakery items and other highly processed foods.

1.2.5 Hydration

- Adequate fluid intake during pregnancy is 2,300 ml/day (EFSA, 2010).
- Requirements increase in warmer ambient temperatures and with physical activity. Estimating requirements becomes vital within clinical settings for women who are unwell and not able to eat or drink liberally.
- Encourage women to drink to maintain pale, straw-coloured to transparent yellow urine with urination frequency of minimum 3-4 times per day

1.3 Micronutrients

1.3.1 Folate/Folic acid

- All women who may possibly become pregnant within the next three months, whether intentionally or not, are advised to take oral FA (FA) 400 micrograms daily to prevent Neural Tube Defects (NTDS)
- Women who intend to become pregnant are advised to start FA at least 6 weeks before they start trying to conceive so that their folate levels are optimised before closure of the neural tube.
- Women who are at increased risk of a pregnancy complicated by a NTD should arrange to see their doctor because they may need a prescription-only higher dose of FA 5.0mg daily. Women who are prescribed 5.0 mg before pregnancy should continue on the same dose for the first trimester
- After the first trimester and during breastfeeding, all women are advised to take FA 400 micrograms to meet the World Health Organization's recommended daily intake for pregnancy and breastfeeding.

1.3.2 Iron

- During pregnancy, a supplement containing 16-20 mg of iron in addition to a balanced diet has the potential of reducing incidence of anaemia in the healthy population.
- Women suspected of iron deficiency require a full blood count (FBC) and, if possible, check serum ferritin. The treatment for iron deficiency anaemia is oral supplementation of 100-200 mg per day as elemental iron. Supplements

that contain 305 mg ferrous fumarate or 325 mg ferrous sulphate are equal to 100 mg elemental iron and readily available.

1.3.3 Calcium

- Pregnant women are advised to eat sufficient calcium rich foods to achieve an intake of 1000 mg per day.
- Three servings of milk, yogurt, cheese or fortified plant-based alternatives within a varied diet provide adequate calcium for most women.
- Women who have a low calcium intake are advised to take a daily supplementation to meet requirements.

1.3.4 Vitamin D

- All pregnant women in Ireland should take a supplement containing 10micrograms (400 IU) Vitamin D_3 per day in addition to inclusion of vitamin D rich foods such as fortified milk and oily fish.

1.3.5 Iodine

- Women of childbearing age, and especially those planning a pregnancy, should ensure that they meet the adult requirement of 150 micrograms iodine daily. Iodine requirements increase to 200 micrograms daily during pregnancy and breastfeeding.
- Two or more servings of milk or yogurt and eating white fish once a week is recommended.
- A prenatal multivitamin supplement containing 200 micrograms iodine daily may be required if dietary sources are inadequate.

1.4 Food Safety

- Practicing food safety is important during pregnancy to reduce exposure to toxicological substances and pathogens which may cause harm to the woman and fetus. (See Tables 10 and 11)

1.5 Specific Diets

- Refer pregnant women who require therapeutic diets to a dietitian.

1.6 Allergies

- It is not recommended that women avoid potentially allergenic foods during pregnancy unless she herself is allergic to a specific food.
- Women who avoid food groups due to allergy or intolerance are at risk of inadequate intake of nutrients. A referral to a dietitian is warranted in these cases.

1.7 Hospital Equipment and Facilities

- A digital weighing scale and a wall-mounted stadiometer (height measure) should be available. The centre must ensure equipment is available in a discrete area and calibrated as per manufacturer instructions to accurately record measurements.
- Hospitals should have access to phlebotomy and laboratory testing.

1.8 Provision of Information on Best Practice for Infant Feeding

- It is the responsibility of all healthcare professionals to promote best practice for infant feeding.
- The National Infant Feeding Policy for Maternity and Neonatal Services and local implementation policy can be found at: https://www.breastfeeding.ie/Resources/Health-professional/Infant-Feeding-Policy-for-Maternity-Neonatal-Services-2019.pdf

2.0 Purpose and Scope

The purpose of this guideline is to improve healthcare professionals' knowledge and dissemination of optimal advice on nutrition during pregnancy while demonstrating the link between good nutrition during pregnancy and a favourable pregnancy outcome.

These guidelines are intended for healthcare professionals who are working in HSE-funded obstetric and gynaecological services in both community and acute services. They are designed to guide clinical judgment but not to replace it. In individual cases a healthcare professional may, after careful consideration, decide not to follow a guideline if it is deemed to be in the best interest of the woman.

Separate guidelines are available for the management of obesity (HSE 2011 Obesity and Pregnancy Clinical Practice Guideline), diabetes during pregnancy (HSE 2010 Guidelines for the Management of Pre-Gestational Diabetes Mellitus from Pre-Conception to the Postnatal Period) and hyperemesis gravidarum (HSE 2015 Hyperemesis and Nausea/Vomiting in Pregnancy). These guidelines can be accessed on the RCPI website: https://www.rcpi.ie/faculties/obstetricians-and-gynaecologists/national-clinical-guidelines-in-obstetrics-and-gynaecology/

3.0 Background and Introduction

Nutrition at time of conception and during pregnancy impacts immediate and long term maternal and infant. Pregnancy is seen as a teachable moment for health promotion, when women are motivated to change. Health care providers can take this unique opportunity to engage and collaborate with women to improve their nutritional intake. The medical team should endeavour to promote healthy lifestyle by "Making Every Contact Count" as part of the Healthy Ireland strategy.

Optimal maternal nutrition will give her baby the best start in life and may subsequently influence health and nutrition of the family unit. As outlined in the National Standards for Safer Better Maternity Services (HIQA, 2016), focus is on supporting women to make positive lifestyle changes while being mindful of social determinants and the ability or limitations to change. The Department of Health is also committed to underpinning health and wellbeing in policy and service delivery to ensure women are empowered to make necessary changes (DOH, 2016). On a global scale, the World Health Organization supports this strategy as they recognise that a woman's positive experience during pregnancy can create the foundations for healthy motherhood (WHO, 2016).

Over 25 years ago, the "Barker Hypothesis" first described the link between fetal nutrition and later development of chronic diseases in adulthood (Barker, 1993; Barker et al, 1995). Poor in utero nutrition can increase adult risk of cardiovascular disease (Kajantie et al, 2005), high blood pressure (Huxley et al, 2000), obesity (Tounian, 2011; Boney, 2005) and metabolic syndrome (Barker et al, 2005). The critical window of opportunity, occurring from conception until 24 months of age, is now commonly referred to as "the first 1000 days". During pregnancy a number of key nutrients are fundamental to the developing fetus. These nutrients and the recommended intakes are outlined in this guideline.

This guideline uses the current evidence to guide health care recommendations. Maternal weight at conception and gestational weight gain also play roles in health outcomes for pregnancy. Babies have increased risk of cardiac death in later life if malnourished in utero (Barker et al, 2012). Maternal diet can influence the type of fetal adipose tissue, which may explain the baby's risk of developing insulin resistance and subsequent diabetes in later life (Symonds et al, 2012). The fuel-mediated in utero hypothesis suggests that increased glucose (carbohydrate) and fat intake during pregnancy results in obesity for the baby in later life (Koletzko et al, 2012). Improved diet and lifestyle regimens potentially reduce this risk (Nelson et al, 2010; Moses et al, 2005.

Obese women are more than twice as likely to give birth to a large-for-gestational age baby compared to women of healthy weight (Sebire et al, 2012), which significantly increases the risk of complications associated with delivery (Boulet, 2003). Women from lower socioeconomic groups are at higher risk of unbalanced nutritional intake and advice must be tailored to their income and needs. Both of these groups of women can benefit from dietetic referral during pregnancy.

In addition to healthy eating advice, women need clear, consistent guidance on the foods to avoid during pregnancy to reduce infection and illness due to exposure of foodborne toxins and pathogens. This guideline provides the latest evidence on the foods to avoid and why they should be avoided. This advice is backed by scientific evidence and any potential risk factors need to be weighed against the benefits when making decisions. For further information and latest reports please refer to the Food Safety Authority Ireland (FSAI) and safefood.

4.0 Methodology

- Medline, EMBASE and Cochrane Database of Systematic Reviews were searched using terms relating to nutrition in pregnancy, fetal programming and nutrition, first 1000 days, diet and pregnancy and specific key nutrients in line with pregnancy.
- Searches were limited to humans and restricted to the titles of English language articles published between 1990-2019
- Relevant meta-analyses, systematic reviews, intervention and observational studies were reviewed.

Guidelines and Evidence Reviewed Included:

- Food Safety Authority of Ireland (FSAI). (2019) Healthy eating, food safety and food legislation: A guide supporting the Healthy Ireland Food Pyramid.
- DoH 2018. Folic Acid Supplementation Policy Report by the Department of Health Folic Acid Policy Committee.
- Safefood, 2017. The Folate Status of Pregnant Women in the Republic of Ireland.
- FSAI, 2016. Update Report on Folic Acid and the Prevention of Birth Defects in Ireland.
- FSAI 2012 Best Practice for Infant Feeding in Ireland: From pre-conception through the first year of infant's life.
- FSAI 2011 Scientific Recommendations for a National Infant Feeding Policy, 2nd Edition.
- HSE 2011. Obesity and Pregnancy Clinical Practice Guideline. Institute of Obstetricians and Gynaecologists, Royal College of Physicians of Ireland and Clinical Strategy and Programmes Directorate, Health Service Executive. April 2011.

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5.0 Guidelines on Gestational Weight Gain

Summary Recommendation:

- All women should have their weight measured and Body Mass Index (BMI) calculated and documented at the first antenatal visit, ideally in the first trimester. BMI checks at the booking visit should be used as a screening mechanism for those at increased risk.
- Women who are identified as underweight at booking should be monitored for weight gain and may benefit from a referral to a dietitian. Women with a BMI <17kg/m^2 should be referred to a dietitian.
- Women should be encouraged to achieve a healthy weight before conception to prevent associated complications. Weight loss in the postnatal period before subsequent pregnancies is an effective strategy for improved outcomes. Postnatal weight loss in overweight and obese women should be encouraged and where available onward referral to community dietetics should be provided.

The amount of weight gained during pregnancy can impact pregnancy outcomes as well as the future health of a woman and her infant.

Prevalence of overweight and obesity has increased over the past number of decades, including among women of childbearing age. In Ireland, in 2016, the mean BMI of women was 27.2kg/m^2 (overweight) with 26.6% of these women classified as obese and 1.2% underweight (NCD-RisC, 2017). Less than half of Irish women have a healthy BMI, with one in two Irish women overweight or obese at their antenatal booking appointment (DOH, 2016).

Pre-pregnancy and postnatal weight loss is the most appropriate target for treatment of obesity. Women who restrict their intake during pregnancy, without a dietetic consultation, are at risk of nutrient deficiencies (IOG, 2011). Women who are underweight, overweight or obese should receive dietary counselling in the community to optimise weight prior to conception and therefore reduce associated risks during pregnancy. Obese women should be encouraged to avoid excessive gestational weight gain through healthy diet and exercise (Daly et al 2017).

5.1 Body Mass Index (BMI)

All women must have a weight and height measured and BMI calculated at the first antenatal visit, ideally in the first trimester (IOG, 2011). Measure the woman's height with her shoes off standing straight using a stadiometer (wall-mounted metre stick) to the nearest 0.1 cm. She should be weighed wearing light clothing (to the nearest 0.1 kg), and the BMI calculated and classified. Self-reporting of height and weight is unreliable (Fattah et al, 2010) therefore, it is essential to check maternal weight and height at an antenatal booking visit. BMI classifies weight from underweight to obesity class III. See Table 1 for BMI classifications.

Table 1: BMI classification

BMI (kg/m^2)	Classification
<18.5	Underweight
18.5-24.9	Healthy
25.0-29.9	Overweight
30.0-34.9	Obesity Class I
35-39.9	Obesity Class II
>40	Obesity Class III

BMI is a surrogate marker of adiposity but does not measure adipose tissue directly or provide information on fat distribution (Fattah et al, 2010; Prentice and Jebb, 2001). It does however offer an affordable and safe screening tool for risk of complications on both ends of the spectrum. Women with BMIs outside the healthy range have increased risk of pregnancy complication. The highest risk appears to be in women within Obesity Class III (Santos et al, 2019; Lifecycle, 2019). Short stature and low weight have been associated with small-for-gestational age infants (SGA) (Goto, 2019), risk for caesarean section and intra-uterine growth restriction (WHO, 1995), while overweight and obesity increases the risk of complications in delivery (IOG 2011), development of gestational diabetes mellitus (Torloni et al, 2009), gestational hypertensive disorders, preterm birth, LGA infants (Santos et al, 2019) and chronic diseases in the infant (Barker, 2012). Preterm birth risk appears to be higher at both BMI extremes (Santos et al, 2019).

It is important that information about obesity and its risks are communicated in an informative, yet sensitive, manner (Schmied et al, 2010; Furber and McGowan, 2011). Women who are underweight may also be sensitive about their weight and compassion is equally important with this patient group.

5.2 Gestational Weight Gain (GWG)

Women gain weight at different rates during pregnancy. Table 2 shows the physiological contributors to weight gain in a singleton pregnancy (ACOG, 2000). Weight can be affected by nutritional intake, gestation, multiple fetuses, physiological stress, genetic factors and fluid retention and these should be taken into consideration on assessment (WHO, 1995). Women who are overweight or obese at booking tend to gain weight more slowly than women of healthy weight (Farah et al, 2011). Gestational weight loss or poor weight gain may increase the risk of SGA babies and pre-term births (Arendras et al, 2008; Kapadia et al, 2015; Xu et al, 2017; Goldstein et al, 2017), particularly in underweight mothers (Santos et al., 2019) but conversely may be more appropriate for women in the highest categories of obesity (Robillard et al, 2018; PMO Lifecycle, 2019). Obese women with high gestational weight gain appear to have the highest risk for pregnancy complications (Santos et al., 2019).

Referral to a dietitian is required to ensure nutritional adequacy in cases of weight concerns in pregnancy. Clinical judgment should be used to determine other clinically relevant causes for change in weight, for example oedema and fetal growth, before making recommendations to modify the rate of weight gain (Rasmussen and Yaktine, 2009).

Table 2: Distribution of weight gain in pregnancy

	Approximate weight gain (BMI 18.5-24.9 kg/m^2 at booking)
Baby	**3.4 kg**
Placenta	**0.7 kg**
Amniotic fluid	**0.9 kg**
Mother	
Breasts	**0.9 kg**
Uterus	**0.9 kg**
Body fluids	**1.8 kg**
Blood	**1.8 kg**
Stores of fat, protein and other nutrients	**3.2 kg**
TOTAL	**13.6 kg**

Adapted from ACOG, 2000

There is no international consensus on appropriate weight gain per BMI category in pregnancy (Alavi et al, 2013, NICE 2010). Normal and inappropriate GWG is not well defined, and the relationships with outcomes in pregnancy are possibly an association rather than a causative effect (O'Higgins et al, 2014). The IOM 2009 guidelines have been shown to be appropriate for women of normal weight however, women who are underweight and obese vary (Robillard et al, 2018). Research indicates that obese women have better outcomes if they gain less weight and class III obese women may have better outcomes if they lose weight (Robillard et al, 2018). For overweight or obese women that gain less than the recommended amount but have an appropriately growing fetus, no evidence exists that encouraging increased weight gain to conform with the current IOM guidelines will improve maternal or fetal outcomes (ACOG, 2013). Women who are overweight or obese at booking tend to gain weight more slowly than normal weight women (Farah et al, 2011) and it appears that maternal obesity rather than the rate of GWG is associated with increased risk of pregnancy complications (O'Dwyer et al, 2013).

A healthy diet and/or moderate exercise during pregnancy can reduce the risk of excessive GWG (Daly et al 2017, Muktabhant B et al, 2015; Rogozinska et al, 2017;), risk of caesarean delivery, macrosomia, and neonatal respiratory morbidity, particularly for high-risk women receiving combined diet and exercise interventions (Muktabhant B et al, 2015). Gestational weight gain is positively associated with weight retention in the years post-partum (O'Brien et al., 2019a), and therefore management of weight gain in pregnancy may be considered a public health priority in preventing women becoming overweight or obese between pregnancies.

On average, women who partake in physical activity during pregnancy have been shown to gain 1-2kg less than their inactive counterparts (Choi et al, 2013; Muktabhant et al, 2015). Not only are more physically active women less likely to gain excessive weight during pregnancy they also demonstrate a lower incidence of gestational diabetes and postpartum depression (Physical Activity Guidelines Advisory Committee, 2018). Guidelines suggest women with uncomplicated pregnancies partake in at least 150 minutes per week of moderate-intensity aerobic activity, spread throughout the week (RCPI, 2016; DoHHS, 2008; UK CMO, Recommendations, 2017; ACOG, 2015). Pregnant women who were sedentary before pregnancy should follow a more gradual progression of exercise, with 10 minute bouts of moderate intensity continuous exercise building up to a total of 150 minutes per week (UK CMO, 2017). Women with medical or obstetric complications should be carefully evaluated before making recommendations on physical activity participation during pregnancy (ACOG, 2015).

Gestational weight loss or slow weight gain may increase the risk of SGA babies and pre-term births (Arendras et al, 2008; Kapadia et al, 2015; Xu et al, 2017). In situations where a patient is losing weight in pregnancy dietetic intervention should be sought to ensure nutritional adequacy. Women should be weighed if there is a concern about inadequate weight gain or weight loss. This includes women on a restrictive diet during pregnancy.

Women who quit smoking after conception tend toward higher GWG and may benefit from additional support and targeted intervention (Hulman et al, 2016).

Antenatal appointments offer an opportunity to utilise the brief intervention model, outlined in the Making Every Contact Count (MECC) Framework (HSE, 2016), supporting the implementation of the Healthy Ireland 2013-2025 framework for chronic disease prevention (DOH, Ireland, 2013). Pregnancy is a time when women have regular healthcare appointments, are keen to receive more information about healthy lifestyle interventions, (Ronnberg et al, 2015) and are motivated to make positive choices toward a good pregnancy outcome (Thangaratinam et al, 2012). The frequent antenatal visits may be utilised to provide lifestyle information during pregnancy as qualitative evidence indicates women appreciate any advice that supports a positive pregnancy and healthy baby (WHO, 2016). This type of advice is more acceptable if delivered in an unhurried and supportive way (WHO, 2016).

Women with lower education level are at an increased risk of gaining both excessive and inadequate weight in pregnancy. International evidence suggests that dietary interventions (more so than physical activity interventions) are associated with greater compliance with gestational weight gain guidelines (O'Brien et al., 2019b).

5.3 Underweight

Nutrition education to increase energy and protein intake is recommended for undernourished pregnant women to reduce risk of SGA neonates (WHO, 2016). Women who are underweight pre-pregnancy that gain less than the IOM recommended range may have a higher than normal rate of infant mortality when compared with infants born to women with adequate GWG (Davis et al, 2014). The greater the severity of maternal underweight (<17kg/m^2), the higher the risk of pre-term birth (Girsen, 2016; Santos et al, 2019). Women who have a BMI below 17kg/m^2 at booking may benefit from gaining more weight than recommended in the IOM guidelines, with a 21.6kg weight gain reducing risk for SGA (Robillard et al, 2018). Underweight women should be encouraged to meet requirements during pregnancy and referred to a dietitian to ensure these needs are met.

5.4 Multi-fetal Pregnancy

Limited evidence is available for multi-fetal pregnancies. IOM guidelines suggest that the weight gain of women pregnant with twins, who have good outcomes, varies with pre-pregnancy BMI. The guideline suggests that women with a healthy BMI gain 17-25 kg, overweight women 14-23 kg and obese women 11-19 kg at term (IOM, 2009). Evidence-based weight gain and nutritional guidelines for triplet pregnancies or higher are lacking. For triplet gestations, a healthy pre-pregnancy BMI and a total GWG of at least 15.9 - 20.5 kg have been associated with fewer pregnancy complications (Eddib et al, 2007). A minimum GWG of 16.3 kg by 24 weeks gestation and a cumulative total GWG of at least 23 kg by 33 weeks has been recommended (Dietitians of Canada, 2013; Brown, 2008). For women carrying quadruplets or higher, there are no set guidelines available and clinical judgment should be exercised.

5.5 Bariatric Surgery

The use of bariatric surgery for the treatment of obesity has led to an increase in the number of women who attend antenatal services following a bariatric procedure. After bariatric surgery, women are recommended to wait at least 12-24 months before conceiving as this period tends to be one of rapid weight loss, with higher risk of nutritional deficiencies (Aills et al, 2008; ACOG, 2009; Mechanick et al, 2013) during which an increased incidence of stillbirth has been reported (Gonzalez et al, 2015). Dietary advice and monitoring of food intake by dietitians with special knowledge of bariatric procedures and experience in advising pregnant women is recommended. If possible, appointments should be performed before pregnancy and at least every trimester, and if necessary even at closer intervals (ACOG, 2009; Mechanick et al, 2013). A greater focus on achieving nutritional requirements in all patients regardless of surgery type is required.

Women after bariatric surgery have low levels of micronutrient stores which require monitoring and repletion as needed (Devlieger et al, 2014). Women should be informed about the importance of nutritional supplementation.

No specific GWG guidelines exist for women following bariatric surgery, with recommendations in line with those of the general population (RCOG, 2015; Khan et al, 2013). Obese women post-bariatric surgery may gain less weight than their counterparts and demonstrate higher rates of IUGR, SGA and preterm births (Aills et al, 2008; Guelinckx et al, 2009). Thus, they represent a high risk group and warrant close surveillance before, during and after pregnancy. Intensive multidisciplinary follow-up is recommended (Busetto et al, 2017). Local clinical judgement should be used to determine the most effective care for individual patients based on GWG, tolerance and fetal growth (Jefferys et al 2013).

5.6 Lactation and Postpartum

Postpartum weight retention may contribute to a woman's lifelong development of obesity. Women are at risk for increased BMI between pregnancies (Crosby 2015), with this increase associated with a higher risk for perinatal complications (McBaina et al, 2016). Booking weight is higher in two-thirds of women presenting for antenatal care in subsequent pregnancies (Crosby, 2015). Excess GWG is also a risk factor for post-partum weight retention (Rong et al, 2015).

Breastfeeding may also decrease the likelihood of future obesity in the offspring (Woo & Martin, 2015). Obese women demonstrate lower intention to breastfeed, lower rates of breastfeeding initiation, as well as shorter duration of breastfeeding in the postpartum period (Turcksin et al, 2014). Thus, these women may benefit from extra support and encouragement in this regard during the antenatal and postnatal period.

Weight loss in the postnatal period before subsequent pregnancies is an effective strategy for improved outcomes (Kral et al, 2006). A reduction in BMI is associated with improved perinatal outcomes in subsequent pregnancies (McBaina et al, 2016).

Women from lower socioeconomic backgrounds are at higher risk of developing obesity postnatally and should be targeted for weight loss interventions (Turner and Layte, 2013). The average Irish woman is overweight beginning her pregnancy and postnatal weight retention will likely push many of these women into the obese category. Women referred to community dietetic services for weight management postpartum will be supported in adopting healthy lifestyle behaviours that may also have an impact on the future health of their offspring.

6.0 Clinical Guidelines on Macronutrients

See Appendix 2 for summary of requirements for energy, carbohydrate, protein and fat.

6.1 Energy

Summary Recommendation:

- Advise women that their dietary energy requirements in the beginning of pregnancy increase only marginally from pre-pregnancy levels. Encourage women to focus on eating well and not only on eating more.
- Energy requirements vary depending on a woman's age, BMI, number of fetuses and activity level. Caloric intake should be individualised based on these factors.

Energy requirements increase during pregnancy due to energy deposited in maternal and fetal tissue, increased basal metabolic rate (BMR) and to changes in the energy cost of physical activity. To define the energy cost of pregnancy, desirable GWG must be stipulated (Butte, 2005).

6.1.1 Requirements

In healthy well-nourished women the average increase in BMR over pre-pregnancy values is found to be 5%, 10% and 25% for the first, second and third trimesters, respectively (Butte, 2005). Total energy costs of pregnancy in well-nourished women are thus estimated from the increment in BMR plus the energy deposition associated with a mean GWG of 12kg. The BMR is calculated based on pre-pregnancy weight. Requirements can be calculated by adding activity factor and the appropriate incremental daily energy requirement per trimester. See Table 3.

Table 3: Additional daily energy requirements per trimester

Trimester	EFSA (2013)	WHO (2004)	IOM (2010)
1st	70kcal	85kcal	NA
2nd	260kcal	285kcal	340kcal
3rd	500kcal	475kcal	452kcal

Energy requirements vary depending on a woman's age, BMI and activity level and calorie intake should be individualised based on these factors. Special consideration needs to be made for women who are either underweight or overweight pre-pregnancy. Women with lower BMI need to gain more weight to produce birth weight comparable to women with normal BMI. Conversely, women with increased BMI need to gain less weight, as reflected in the IOM recommendations for GWG.

There is no ideal prediction equation for energy requirements in pregnancy and any calculation should be given with frequent monitoring of maternal GWG and fetal growth (INDI, 2015). Thus monitoring weight gain versus calorie intake is beneficial.

6.1.2 Multi-fetal Pregnancy

Energy requirements for women carrying multiple foetuses are higher than for singleton. The increase in resting energy expenditure accounts for the increased mass of maternal tissues, including the breast, uterus, body fat, and muscle as well as the increase in blood volume. This can result in a 40% increase in energy requirements for twin gestations (Goodnight et al, 2009).

There are no standardised guidelines for women carrying twins or more, but they have been extrapolated from those for singletons. For women with a normal BMI carrying more than one fetus an estimated 40-45kcal/kg pre-pregnancy weight per day has been recommended, ensuring that adequate weight gain is used as an indicator of sufficient energy intake (Goodnight et al 2009). For underweight women carrying multiple foetuses, the estimate is 42-50kcal/kg pre-pregnancy weight per day, whereas for overweight women, 30-35kal/kg pre-pregnancy weight per day has been suggested.

6.1.3 Lactation

For women exclusively breastfeeding during the first six months after birth, the additional energy requirements during lactation has been estimated at 500kcal/day over pre-pregnancy requirements (EFSA, 2013). Women should again be advised to choose foods with a high nutrient density and quality.

6.2 Carbohydrate and Fibre

Summary Recommendation:

- An RDA of 175g per day is set, based on adequate blood glucose for utilization by the maternal and the fetal brain. This can be met with 3 servings of fruit, 2 servings of vegetables, 3 servings of milk or yoghurt and 3 servings of whole grains.
- Women are encouraged to eat a variety of whole grains, fruit, vegetables, legumes (starchy beans, lentils and pulses), nuts and seeds to meet fibre requirements.

Carbohydrates are important energy sources for every cell and system in the body. During pregnancy there is an increase in demand for carbohydrate in the form of glucose for maternal and fetal brain, central nervous system and red blood cell function, fetal growth and energy stores. The amount of dietary carbohydrate necessary for optimal human health is unknown.

6.2.1 Carbohydrate Requirements

An RDA of 175g per day is set, based on adequate blood glucose for utilization by the maternal and fetal brain, the only truly carbohydrate-dependant organ (IOM 2005).

6.2.2 Sources

Natural carbohydrates in the form of sugars, starches and fibres are found in grains, fruits, vegetables, nuts/seeds, milk and yoghurt. There is no evidence to suggest a certain portion of carbohydrates should come from starches or sugars (IOM, 2005). Given that natural carbohydrates are also valuable sources of vitamins, minerals, fibre, antioxidants and phytonutrients to support health, the National Healthy Eating Guidelines offer advice on a range of intakes to meet dietary requirements for the population. Based on suggested serving sizes from The Food Pyramid, the RDA of 175g of carbohydrate can be met with 3 servings of fruit, 2 servings of vegetables, 3 servings of milk or yoghurt and 3 servings of whole grains (HSE, 2016).

Carbohydrates foods such as crisps, sugar-sweetened breakfast cereals, added sugars, sweets, biscuits, desserts and sugary drinks are of low nutrient value and can contribute to excess weight gain and heart disease. These foods also replace other, more nutritious choices which can lead to insufficient intake of concomitant nutrients. Advice to limit foods high in sugar, fat and salt to no more than two servings per week applies to the whole population and does not change for pregnant women (HSE, 2016). Though serving sizes for these individual foods vary, a serving of added sugar is one teaspoon.

6.2.3 Fibre Requirements

Dietary fibre is non-digestible carbohydrate and lignin, therefore contribute little or no energy. Diets rich in fibre aid in regular bowel function, reduction in blood cholesterol and modulate blood glucose levels (Mousa, 2019). Adequate intake of fibre to support normal laxation for adults is 25g per day (EFSA, 2017). As constipation is common in pregnancy due to hormonal changes to bowel tone, an increase to 28g per day has been recommended (IOM 2005). Women are encouraged to take a variety of whole grains, fruit, vegetables, legumes (starchy beans, lentils and pulses), nuts and seeds daily to meet these requirements (FSAI 2011).

6.2.4 Multi-fetal Pregnancy

There is limited evidence to advise specific carbohydrate and fibre intakes for multi-fetal pregnancies (Bricker, 2015). Additional energy for fetal growth and maternal wellbeing can be met with an additional daily intake of 1-3 servings from each of these food groups above recommended for a singleton pregnancy: whole grains, fruit, vegetables and milk or yoghurt. Fetal growth, weight gain, maternal well-being should be monitored and individual dietary preferences should be taken into account.

6.2.5 Lactation

The RDA for carbohydrate during lactation is based on adequate intake to replace the content in average human milk and for maternal brain utilization (IOM 2005). Estimated requirements during lactation are 210g per day. Assuming the woman has a balanced diet, this increased energy requirement can be also be met concurrently with the recommended increased intake of calcium from milk and yoghurt to 5 servings daily plus an additional serving of fruit. Adequate intake of fibre during lactation is 25 g per day, as for the general adult population.

6.3 Protein

Summary Recommendations:

- Adequate dietary protein intake throughout pregnancy is essential to ensure normal growth and development of the fetus.
- Two servings of protein foods per day in the first and second trimester and three servings in the third trimester will meet these requirements.
- For women who are undernourished or underweight, a balanced protein/energy nutrient supplement may be useful in pregnancy, but only under medical and dietetic supervision.

Adequate dietary protein intake throughout pregnancy is essential to ensure normal growth and development of the fetus as it forms the structural basis for all new cells and tissues. Both excessive and insufficient dietary protein intake have been associated with intrauterine growth restriction and subsequently low birth weight and small for gestational age (Ota *et al.,* 2015).

6.3.1 Requirements

The fetus and placenta consume approximately 1kg of dietary protein throughout pregnancy, primarily in the second and third trimesters. To fulfil this need, women require 0.83g/kg with an additional 1g, 9g and 28g/day in the first, second and third trimesters respectively (EFSA, 2015). See Table 4.

Table 4: Protein requirements per trimester

Trimester	Additional protein	Recommended servings from Food Pyramid
1st	1 g	2
2nd	9 g	2
3rd & lactation	28 g	3

6.3.2 Sources

In order to meet their requirements, pregnant women need to include at least 2 servings per day of a variety of lean protein rich foods in the first and second trimesters and 3 servings in the third trimester (DOH, 2016).

One serving is one of the following:

- 50-75g of cooked lean beef, lamb, pork, mince or poultry
- 100g of cooked fish, soya, tofu or tempeh
- 2 eggs
- 175g of kidney beans/lentils/black beans/dal
- 40g of unsalted nuts or seeds

It is important to consider the source of dietary protein. A high intake of processed meats such as sausages, chicken nuggets and burgers has been associated with a greater risk of small for gestational age infants (Knudsen et al 2008), while a diet containing less processed meats and more fish and eggs may reduce this risk (Ricci et al 2010). Therefore, pregnant women should be advised to limit salted processed meats and choose fresh meat, poultry, fish and plant sources of protein more frequently.

According to Irish food surveys, the majority of women in Ireland meet protein requirements (McGowan and McAuliffe, 2012). Women who have reduced nutritional intake due to nausea or vomiting of pregnancy are at risk of not meeting requirements. Women from lower socioeconomic groups may not meet requirements due to the associated costs of protein-rich foods (McCartney et al., 2013) and more likely to choose less expensive processed foods. This vulnerable group requires advice on lower cost, high quality proteins such as eggs, beans, tinned fish, chicken and lentils.

6.3.3 Multi-fetal Pregnancy

Protein requirements for women with multi-fetal pregnancy are estimated at an additional 50g protein/day in the second and third trimesters. Advise these women to include at least 4 servings per day of lean protein-rich foods (IOM, 2006).

6.3.4 Lactation

Lactating women require on average, an additional 19g of protein per day (EFSA, 2015). This can be achieved by including at least 3 servings per day of lean protein-rich foods.

6.3.5 Protein Supplements

The use of protein powders, beverages or any other high protein supplements is not recommended in pregnancy. Current best evidence states that high protein supplementation alone does not offer clinical benefits, even in undernourished women (Ota, 2012; Kramer & Kakuma, 2003). In women who have adequate protein intake, high protein supplements may increase the risk of small for gestational age (SGA) neonates (Blumfield, 2014; WHO, 2016). However, in women who are undernourished and underweight, a balanced protein/energy nutrient supplement may be useful in pregnancy, but only under medical and dietetic supervision (Imdad, 2011; Kramer & Kakuma, 2003).

6.4 Fat

Summary Recommendations:

- National healthy eating guidelines are applicable to pregnant women in relation to fat intake.
- Pregnant women should be advised to minimise the intake of saturated fatty acids during pregnancy, while ensuring that intake of other nutrients which coincide with saturated fat in the food supply (e.g. iron, vitamin B_{12}, calcium) remain adequate.
- Pregnant women should be advised to minimise or avoid dietary intake of trans- fatty acids during pregnancy.
- Encourage pregnant women to eat additional EPA and DHA by eating 1-2 portions of oily fish per week.

Optimal quality and quantity of dietary fat intake in pregnancy is unclear. National recommendations for fat intake in the general population apply. However, there is evidence which supports the minimisation of saturated and trans-fatty acids, as well as an increased intake of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) during pregnancy and lactation.

6.4.1 Saturated Fats

The US Healthy Heart Study (Crume, 2016) revealed that a higher proportional intake of saturated fatty acids, coincident with a lower intake of other macronutrients (including refined sugar), was associated with increased neonatal fat mass. Other studies link excessive saturated fat intake to higher neonatal adiposity, weight-for-age and waist-to-hip circumference ratio at 6 months old and development of obesity, insulin resistance and cardiovascular disease later in life (Murrin, 2013; Horan, 2016;Horan, 2014; Mennitti, 2015). Therefore women should be encouraged to limit fat especially.

The main sources of saturated fat include fatty beef, lamb, pork, poultry eaten with skin, beef fat (tallow), lard, cream, butter, cheese and other dairy products made from whole or reduced-fat (≤2 %) milk. Many baked goods and fried foods also contain high levels of saturated fats. It is recommended to advise pregnant women to choose lean, meats and low fat dairy and limit process proteins, baked goods and fried meats, while ensuring adequate intake of other nutrients which coincide with saturated fat in the food supply (e.g. iron, vitamin B_{12}, calcium).

6.4.2 Trans Fats

Maternal trans-fatty acid consumption during critical periods of fetal development may contribute to the development of metabolic diseases in childhood and later life (Innis, 2006; Mennitti, 2015).

Trans-fatty acids are transported across the placenta in proportion to maternal intake. They compete strongly for the same long-chain polyunsaturated fatty acid (LC-PUFA) binding sites on placental and other membranes and may inhibit the transport of LC-PUFAs across the placenta, compromising the mother's synthesis of LC-PUFA for the fetus (SACN, 2004). This may lead to alterations in the development of the hypothalamic centres that control appetite (Murrin, 2013), increasing the risk of metabolic diseases. Pregnant women are advised to minimise or avoid dietary intake of trans-fatty acids during pregnancy.

The main sources of trans-fatty acids include fried foods like doughnuts, and baked goods including cakes, pies, biscuits, pastries and confectionery (FSAI, 2016).

6.4.3 Polyunsaturated Fat (Omega-3 Fatty Acid) Requirements

Long-chain polyunsaturated fatty acids (LC-PUFAs) make up almost half of the lipid content of the brain. The fetus depends on maternal supply of LC-PUFAs due to its limited ability to synthesise them from precursor fatty acids (Herrera, 2002).

DHA and EPA (also known as omega-3 fatty acids) are, two important LC-PUFAs necessary for the normal development of the brain and retina. There is mixed evidence regarding the effectiveness of omega-3 supplementation during pregnancy to improve neurodevelopment in children. However, evidence from a double-blind, randomised controlled trial found that 600mg DHA per day in the second half of pregnancy resulted in longer gestation and larger infant size at birth (Carlson, 2013). In addition, higher DHA and EPA intakes have been associated

with lower neonatal skinfold thickness measures (adiposity), but further research is required in this area (Rytter, 2011).

Table 5: EPA plus DHA requirements (EFSA, 2010)

	Requirements	Recommended servings
Non-pregnancy	1750mg / week EPA + DHA	1-2 servings of oily fish per week
Pregnancy	Additional 700-1400mg/week DHA	1-2 servings of oily fish per week*

*See section 9.0 food safety recommendations regarding fish and seafood.

DHA and mercury content of fish vary independently: anchovies, Atlantic herring, Atlantic mackerel, mussels, salmon, sardines, snapper and trout are generally high in DHA and low in mercury content.

Note: foods fortified with omega-3 PUFA such as yoghurt, milk and eggs are becoming more widely available, however, many of these fortified foods contain the plant-based omega-3 PUFA (alpha-linolenic acid), which cannot be readily converted to their bioactive derivatives EPA and DHA.

Table 6: The main dietary sources of long-chain polyunsaturated fatty acids

	Omega-6	Sources
Essential fatty acids	Linoleic acid (LA)	Soybean, safflower, sunflower and corn oils; green leafy vegetables; nuts and seeds
LCPUFAs	Arachidonic acid (AA)	Egg yolk, beef, pork, chicken (particularly organ meats)
	Gamma-linoleic acid (GLA)	Evening primrose, blackcurrant oils
	Omega-3	**Sources**
Essential fatty acids	Alpha-linolenic acid (ALA)	Soybean, rapeseed (canola), flaxseed and walnut oils; nuts and seeds
LCPUFAs	Eicosapentaenoic acid (EPA)	Fish oils, oily fish (anchovies, Atlantic herring, Atlantic mackerel, mussels, farmed and wild salmon, sardines, snapper and trout)
	Docosahexaenoic acid (DHA) / Docosapentaenoic acid (DPA)	

6.4.4 Monounsaturated Fats

There is insufficient evidence at this time to make pregnancy specific recommendations for the intake of monounsaturated fatty acids. Therefore, pregnant women should be advised to follow existing dietary guidelines for the general population.

7.0 Clinical Guidelines on Micronutrients

See Appendix 3 for summary of recommendations for micronutrient intake in pregnancy and lactation.

7.1 Folate/ folic acid

Summary Recommendations:

- All women who may possibly become pregnant within the next three months, whether intentionally or not, are advised to take oral FA (FA) 400 micrograms daily to prevent Neural Tube Defects (NTDS)
- Women who intend to become pregnant are advised to start FA at least 6 weeks before they start trying to conceive so that their folate levels are optimised before closure of the neural tube.
- Women who are at increased risk of a pregnancy complicated by a NTD should arrange to see their doctor because they may need a prescription-only higher dose of FA 5.0mg daily. Women who are prescribed 5.0 mg before pregnancy should continue on the same dose for the first trimester
- After the first trimester and during breastfeeding, all women are advised to take FA 400 micrograms to meet the World Health Organization's recommended daily intake for pregnancy and breastfeeding. This promotes fetal and neonatal development as well as reducing the risk of anaemia in the mother
- Women who are considered at increased risk include women who:

  (a) experienced a previous pregnancy complicated by a NTD

  (b) have pregestational Type 1 or 2 diabetes mellitus

  (c) have a first degree relative diagnosed with a NTD

  (d) are on certain medications (check medications on latest *Monthly Index of Medical Specialities Ireland MIMS*)

  (e) with moderate or severe obesity (BMI > 34.9 kg/m^2).

All women should follow the National Guidelines for Healthy Eating but they should be aware that increasing their dietary intake of folate alone is unlikely in the absence of mandatory food fortification or FA supplementation to achieve optimal maternal folate levels.

(See Department of Health Folic Acid Policy, 2018)

Neural Tube Defects

Neural tube defects (NTDs) are the most common major malformation of the central nervous system in the developing fetus and include anencephaly, encephalocele, hydranencephaly, iniencephaly and spina bifida, as well as rarer forms. These defects arise at an early stage of pregnancy, between 21 and 28 days after conception, a time when many women do not yet realise they are pregnant as they have not yet experienced a missed menstrual period. The incidence of NTDs in Ireland remains high by European standards (EUROCAT, 2010; EUROCAT, 2014; McDonnell, 2014; McDonnell, 2018). The majority of young women in Ireland are not adequately protected against NTDs due to both low folate intakes from food and lack/insufficient use of pre-conceptual supplements (Safefood, 2017). Only 2.6% of women in Ireland presenting for antenatal care are achieving adequate dietary folate (Safefood, 2017).

A number of recent reviews reinforce the role of folate in the prevention of NTDs and in supporting the development of the fetus in utero, as well as in supporting maternal health during pregnancy and lactation (Molloy, 2008; Burke, 2009; Boilson, 2012; Lassi, 2013; WHO, 2015; McDonnell, 2018). In addition, the importance of sufficient folate both before and during pregnancy in preventing maternal anaemia is becoming increasingly apparent (O'Malley, 2018) with co-existent iron deficiency an additional consideration (Molloy, 2014).

7.1.2 Sources

Dietary sources include:

- naturally occurring folates in fruit, vegetables, beans, pulses and
- folic acid, the synthetic form used in food fortification of some breakfast cereals and milk.

Promotion of a healthy diet pre-pregnancy and during early pregnancy is important but dietary sources alone are insufficient to confer protection (Molloy, 2008; Obeid, 2014; Hopkins 2015; Kelly, 2015). Folic acid fortification is not mandatory in Ireland and folates present in fruit and vegetables are reduced by heat, light and bruising and several factors impact on individual absorption rates.

A 'whole diet' approach is advocated to optimise bioavailability, with an emphasis on following the healthy eating guidelines in addition to daily FA supplementation to reduce the risk of NTDs.

7.1.3 Supplementation

Folic acid is the synthetic, stable version of folate with a predicable dose response effect on red blood cell folate. FA is used in food fortification and in oral supplements. Supplementation with FA has been demonstrated to protect against NTDs for 70% of the target population. All women who could conceive are encouraged to achieve adequate red cell folate by taking a 400 microgram supplement of folic acid daily in addition to dietary sources, for at least 12 weeks prior to trying to conceive. Supplemental FA can be continued throughout pregnancy and breastfeeding either as a single supplement of 400 micrograms/ day or as part of a pregnancy multivitamin if preferred.

Women who are at increased risk are advised to take a higher dose of folic acid to mitigate an increased likelihood of an NTD in their developing fetus. Women who are considered at increased risk include women who: experienced a previous pregnancy complicated by a NTD, have pregestational Type 1 or 2 diabetes mellitus, have a first degree relative diagnosed with a NTD, are on certain medications (check medications on latest *Monthly Index of Medical Specialities Ireland MIMS*), with moderate or severe obesity (BMI > 34.9 kg/m^2).

The higher dose most widely available on the Irish market is 5mg and needs to be prescribed. This dose should be continued throughout the first trimester and 400 microgram/ day recommended as a single supplement or within a prenatal multivitamin for the duration of pregnancy and breastfeeding (FSAI, 2016; Safefood 2017).

7.2 Iron

Summary Recommendations:

- During pregnancy, a supplement containing 16-20 mg of iron in addition to a balanced diet has the potential of reducing incidence of anaemia in the healthy population.
- Women suspected of iron deficiency require a full blood count (FBC) and, if possible, check serum ferritin. The treatment for iron deficiency anaemia is oral supplementation of 100-200 mg per day as elemental iron. Supplements that contain 305 mg ferrous fumarate or 325 mg ferrous sulphate are equal to 100 mg elemental iron and readily available.

Iron is an essential component of hundreds of proteins and enzymes. As a component of haem it is responsible for oxygen transport, energy production and DNA synthesis (SACN, 2010).

7.2.1 Requirements

An iron intake of 16mg per day is essential throughout pregnancy to meet the increased requirement for fetal and placental growth, while maintaining adequate maternal stores to cover losses from childbirth. Several portions of iron rich foods daily are encouraged (table 7 & table 8).

During pregnancy, the fetus requires a large red blood cell mass to provide sufficient oxygen for development and growth. Iron requirements increase progressively after 25 weeks gestation to combat the lower oxygen environment in the womb (Dewey and Chaparro, 2007). Adaptations in iron transporters and maternal intestinal absorption facilitate delivery of iron to the fetus to meet these requirements (SACN 2010). Due to these maternal adaptations, along with cessation of menstrual losses, iron requirements are estimated to be the same as premenopausal women. Requirements for pregnancy are 16 mg per day (EFSA 2015).

7.2.2 Sources

Iron in the diet exists as haem iron and non-haem iron. Haem iron is readily absorbed and found nearly exclusively in animal tissues. Non-haem iron, sourced from animal and plant tissues, is absorbed less efficiently. Tables 7 and 8 list sources and iron content of common foods.

Table 7: Food sources and content of haem iron

Haem Iron Sources			
Food	**Iron mg Per 100g**	**Recommended Serving size (g)**	**Iron content (mg)**
Lean Beef	2.6	75	1.9
Beef Mince	2.3	75	1.7
Lamb cutlets	2.0	75	1.5
Pork Chops	1.3	75	1.0
Chicken Breast	1.0	75	0.8
Salmon	0.8	100	0.8
Tinned salmon	0.6	100	0.6
Tinned sardines	2.3	100	2.3
Cod	0.4	100	0.4

Table 8: Food sources and content of non haem iron

Non-haem Iron Sources		
Food	**Portion (g)**	**Iron content (mg)**
Fortified breakfast cereal	30	2.4-4.2
Baked Beans	150	2.1

Spinach	90	1.8
Egg (2 whole)	50	1
Wholemeal bread, slice	36	0.9
Broccoli	85	0.9
Dried Fruit	25	0.6

Absorption of non-haem iron can be enhanced with concomitant intake of vitamin C from fruit, fruit juice and certain vegetables. Tannins found in tea and coffee should be avoided at meal times as they can inhibit iron absorption from the diet (FSAI, 2011). Dietary sources of zinc, vitamin C, vitamin A, folate and copper are also important for haemoglobin synthesis. A food-based approach is best to meet requirements for all these nutrients.

7.2.3 Supplementation

Preventing anaemia

National nutrition surveys and research in maternity services show that the majority of Irish women do not meet their daily iron requirements during childbearing years or pregnancy (IUNA, 2011; SLÁN, 2007; McGowan and McAuliffe, 2012). An iron-rich diet in addition to appropriate supplementation has the potential of reducing incidence of anaemia in pregnancy and subsequent adverse outcomes, therefore the threshold for iron supplementation in pregnancy should be low (Barroso et al, 2011).

During pregnancy, a supplement containing 16-20 mg of iron in addition to a balanced diet is effective to maintain adequate stores in the healthy population (Health Canada, 2009) to reduce risk of anaemia (Pena-Rosas, 2015). Intermittent oral iron (120 mg with 2800 micrograms FA) once a week or every second day is recommended when daily iron supplementation is not tolerated due to side effects (WHO, 2016). As haemoglobin (Hb) levels >13g/dL have also been associated with poor obstetric outcomes, advice on iron supplementation should be individualised (SACN, 2010). Women with Hb >13 g/dL are advised to avoid supplementation.

Treating anaemia

A recent analysis of 312,281 pregnancies in 29 countries showed the odds of maternal death were twice as high in women with severe anaemia compared with those without (Daru et al 2018).

Symptoms of iron deficiency include shortness of breath during normal activity, fatigue and palpitations. Women suspected of iron deficiency should have a full blood count (FBC) and, if possible, serum ferritin analysed. Haemoglobin levels <11g/dL in the first trimester and <10.5g/dL in the second/third trimesters indicate

iron-deficiency anaemia (WHO, 2016). Serum ferritin <15 micrograms/L indicates iron depletion in all stages of pregnancy (Pavord et al, 2012). The treatment for iron deficiency anaemia is oral iron supplementation (NICE, 2008). Doses 100-200mg per day of elemental iron should be adequate to replenish stores (Pavord et al, 2012). Supplements that contain 305 mg ferrous fumarate or 325 mg ferrous sulphate are equal to 100 mg elemental iron and readily available. If a woman is diagnosed with anaemia, 100-120 mg elemental iron should be increased until her Hb level rises to > 11.0g/dl after which she can return to a standard dose (WHO, 2016).

Iron supplements can cause unpleasant gastrointestinal (GI) side effects resulting in poor compliance, impair absorption of other minerals, and increase risk of haemoconcentration (Zhou et al, 2009). Intermittent dosing (every second or third day) or lower dose iron preparations seem to be effective in preventing or treating anaemia without unpleasant GI symptoms (Pena-Rosas, 2015; SACN 2010). Note: Despite its high iron content, liver should be avoided in pregnancy due to the high level of pre-formed vitamin A (FSAI, 2011).

7.2.4 Multi-fetal Pregnancy

The iron requirement for twin pregnancy is estimated to be nearly twofold that of a singleton. Iron supplementation during the first and second trimesters has been associated with reductions in both preterm birth and LBW (Goodnight, 2009).

7.2.5 Lactation

Women should maintain an iron-rich diet postpartum to assist with wound healing and replenish stores. Women with anaemia postpartum are at increased risk and severity of infection (Ekiz et al, 2005), reduced work capacity and performance (Haas et al, 2001) and disturbances in cognition and emotions (Beard et al, 2005). There is limited evidence on the optimal treatment of postpartum anaemia (Markova et al, 2015). Iron supplementation in combination with monitoring, advice and treatment of GI symptoms is recommended.

7.3 Calcium

Summary Recommendations:

- Pregnant women are advised to eat sufficient calcium rich foods to achieve an intake of 1000 mg per day.
- Three servings of milk, yogurt, cheese or fortified plant-based alternatives within a varied diet provide adequate calcium for most women.
- Women who have a low calcium intake are advised to take a daily supplementation to meet requirements.

Calcium is an integral part of bone structure, giving the properties of rigidity, strength and elasticity. Ninety-nine percent of corporal calcium is present in bone and teeth. The remaining 1% acts an intracellular messenger in cells and tissues,

regulating metabolic processes, vascular contraction and dilation, muscle contraction, neural transmission and glandular secretion.

An inverse relationship has been described between calcium intake and hypertensive disorders of pregnancy from epidemiological and clinical studies since the 1980's (Belizan and Villar, 1980). It is suggested that low dietary calcium intake stimulates the release of parathyroid hormone or renin, resulting in increased intracellular calcium in vascular smooth muscle which causes vasoconstriction (Hofmeyr et al., 2014). The current consensus from the 2014 Cochrane review is that calcium supplementation (≥ 1000 mg/day) significantly reduces the risk of pre-eclampsia and preterm birth among women with low calcium diets (Hofmeyr et al., 2014).

Accretion of 30, 60 and 300 mg/day of calcium takes place in trimester one, two and three, respectively (Givens and Macy, 1933; Prentice, 2000; Institute of Medicine, 2011; Kovacs, 2016). Physiological adaptations occur during pregnancy to meet foetal calcium requirements, facilitated through doubling of maternal intestinal calcium absorption and mobilisation of calcium from maternal bones (Kovacs and Ralston, 2015). The maternal skeletal calcium can be resorbed if calcium is required for the fetus (Kovacs, 2016). The mechanisms involved in bone metabolism in pregnancy are not fully understood. An imbalance in bone metabolism with resorption exceeding formation may result in negative bone remodelling in the pregnant woman and could characterise pregnancy as a period of vulnerability for maternal skeletal health (Sanz-Salvador et al., 2015). Preliminary Irish evidence suggests that maternal low calcium intake in trimester three is associated with lower maternal bone mineral density five years after pregnancy (O'Brien et al., 2018).

7.3.1 Requirements

The European Food Safety Authority established a population reference intake (PRI) of 1,000 mg/day for adults 18 – 24 years and 950 mg/day for adults ≥25 years (EFSA, 2015). The PRI is similar to the RDA in that it meets the needs of virtually all (97.5%) members of the population. Considering the increases in intestinal calcium absorption during pregnancy, it is recommended that non-pregnant requirements be applied to pregnant women (IOM, 2011; EFSA, 2010; EFSA, 2015). In Ireland, calcium intakes are generally good among pregnant women with estimated intakes of 877 – 919 mg/day (McGowan and McAuliffe, 2012; Mullaney et al., 2016). A study of Irish women, which included contribution from calcium supplements, found higher intakes of 1,227 mg/day (O' Callaghan et al., 2016).

7.3.2 Sources

Calcium can be found in foods naturally and due to fortification. Three servings of calcium rich foods in addition to minor contributors (green leafy vegetables, almonds, beans, seeds) should be adequate for most women. Adolescents will require five servings to meet requirements for maternal and fetal growth. See sources in Table 9.

Calcium supplements may be needed for some women with low dietary intake. Absorption is greatest when supplements ≤500mg are consumed. If a woman is advised to take 1,000 mg/day of calcium from supplements, it would be preferable to split the dose and take 500 mg at two separate times during the day.

Table 9: Calcium-containing foods

Food source	Portion size	Calcium content
Cow's milk	200 ml	240 mg
Cheese	28 g	240 mg
Yoghurt	125 g	240 mg
Alternative milks, fortified	200 ml	240 mg
Rice pudding	200g (half large tin)	175 mg
Tinned sardines (eaten with soft bones)	60 g (half tin)	260 mg
Soya bean curd/tofu (Set with calcium chloride (E509) or calcium sulphate (E516), not nigari)	60 g	200 mg
Calcium fortified instant hot oat cereal	15g dry cereal (1 tbsp)	200 mg
Calcium-fortified orange juice	150 ml	180 mg
White bread	2 large slices	100 mg
Boiled broccoli	2 spears (85 g)	34 mg

7.3.3 Multi-fetal pregnancy

There is limited evidence regarding calcium requirements in pregnancies of twins or higher multiples. It has been suggested that bone resorption is greater in twin compared to singleton pregnancies (Nakayama et al., 2011), and perhaps need greater calcium intake. Recommending up to 5 servings of calcium rich foods daily is pragmatic and will increase women's intake of other essential micronutrients such as iodine.

7.3.4 Lactation

Calcium requirements during breastfeeding are similar to those in pregnancy. It has been recognised that during lactation, maternal bone resorption is transient, and calcium intakes greater than those recommended in pregnancy do not supress

bone resorption or alter the calcium content of breast milk (Institute of Medicine, 2011).

7.4 Vitamin D

Summary Recommendations:

- All pregnant women in Ireland should take a supplement containing 10micrograms (400 IU) Vitamin D_3 per day in addition to inclusion of vitamin D rich foods such as fortified milk and oily fish.

Vitamin D is a fat-soluble vitamin essential for absorption of dietary calcium and may play a role in normal immune system function (Fronczak, 2003; Hypponen, 2001). Adverse effects of low serum 25(OH)D concentration on maternal reproductive health may include pre-eclampsia/PIH, increased risk of operative delivery, intrahepatic cholestasis of pregnancy and periodontal disease in pregnancy (SACN, 2016). There is also some evidence to suggest that prenatal supplemental vitamin D may reduce risk of adverse pregnancy outcomes including neonatal hypocalcaemia, rickets and osteomalacia and may reduce the risk of persistent/recurrent wheeze or asthma in children. (EFSA, 2018;Bärebring, 2018; Munns, 2016; Roth, 2017). Surveys of the Irish population show that the average intake of vitamin D is well below the recommended level (SLAN, 2007; IUNA, 2011). It is of particular concern that suboptimal intakes and low serum vitamin D levels have been reported in cohorts of pregnant women in Dublin, Cork and Belfast (McGowan, 2011; Mullaney, 2016; O'Riordan, 2008;Holmes, 2009). Observational studies of pregnant women in Ireland have also revealed significant levels of vitamin D deficiency and insufficiency (O'Brien, 2017; Kiely, 2016; Walsh, 2013).

7.4.1 Requirements

The Food Safety Authority set the RDA (recommended dietary allowance) for vitamin D at 5 micrograms (200 IU) per day for pregnant women (FSAI 1999). More recent guidelines from The European Food Safety Authority (EFSA), American College of Obstetrics and Gynaecologist and The Endocrine Society Global Consensus recommend an intake of 15 micrograms (600 IU) daily from all sources (EFSA 2018; Munns, 2016; ACOG, 2011) whereas The UK recommends that pregnant women take a vitamin D supplement of 10 micrograms daily (NICE 2008).

In the absence of updated Irish RDAs and given the known inadequacy of dietary intakes in Ireland, it is advisable for pregnant women in Ireland to take a daily supplement containing 10 micrograms (400 IU) vitamin D_3. The majority of over-the-counter prenatal multivitamins contain 10 micrograms of vitamin D_3, therefore if a woman chooses to take a prenatal multivitamin she will not require additional vitamin D supplementation. Women who choose a strict vegetarian or vegan diet are advised to take a supplement in form of ergocalciferol (vitamin D_2).

If there is a history of rickets in a sibling or a known maternal vitamin D deficiency, a higher, treatment dose is warranted as the neonatal serum vitamin D will be 60% of the maternal level. The number of trials and outcomes reported are too limited, and in general too low in quality, to draw conclusions on the usefulness and safety

of high doses of vitamin D supplementation as a part of routine antenatal care. The EFSA established the upper limit of 100 micrograms/day (4000 IU) which applies to all adults, including pregnant and lactating women (EFSA, 2012).

7.4.2 Sources

Vitamin D_3 is found naturally in few foods. Dietary sources include the flesh of oil-rich fish, some fish liver oils (fish liver oil should be avoided in pregnancy due to vitamin A content), and eggs from hens fed vitamin D. Fortified sources including margarine, milk and cereals are also widely available. Vegan-friendly vitamin D_2 is predominately sourced as supplements. Humans can synthesize vitamin D cutaneously; however, above latitudes of approximately 40°N such as in Ireland from October to March, vitamin D cannot be synthesized. The UV light required to promote vitamin D synthesis cannot penetrate the atmosphere during this time. Furthermore, sun exposure may increase the risk of melanoma, and so advising sun exposure is not a viable public health strategy to combat low vitamin D levels.

7.4.3 Multi-fetal Pregnancy

There is no guideline for vitamin D intake with twins or higher multiples. Considering the frequent occurrence of complications resulting in bed rest for women carrying multiples, and therefore limited cutaneous vitamin D synthesis, supplementation may be particularly important.

7.4.4 Lactation

Recommendations for vitamin D do not differ for lactating women. Again, as dietary sources are not consistently adequate, supplementation of 10 micrograms per day is prudent (EFSA, 2012). Vitamin D content of human milk is not sufficient to maintain stores in breastfed infants, therefore the HSE recommends that infants be given vitamin D drops orally (5 mcg vitamin D daily) until 12 month of age and when dietary sources are adequate (HSE, 2010; FSAI, 2011).

7.5 Iodine

Summary Recommendations:

- Women of childbearing age, and especially those planning a pregnancy, should ensure that they meet the adult requirement of 150 micrograms iodine daily. Iodine requirements increase to 200 micrograms daily during pregnancy and breastfeeding.
- Two or more servings of milk or yogurt and eating white fish once or twice a week or is recommended.
- A prenatal multivitamin supplement containing 200 micrograms iodine daily may be required if dietary sources are inadequate.

Iodine is an essential nutrient required for the biosynthesis of thyroid hormones, which are responsible for regulating growth, development and metabolism. Iodine requirements increase substantially during pregnancy and breastfeeding. Thyroid function is increased during pregnancy as thyroid hormones produced by the mother (and the fetus as the pregnancy progresses) are essential for growth of the fetus and to regulate the development of the fetal brain and nervous system. If women have too little iodine during pregnancy or infants have too little during early childhood, the damage may be irreversible. Research has shown that severe iodine deficiency can stunt children's normal physical growth and mental development, resulting in lower intelligence quotients (Harding 2017). A review of the impact of iodine status on the cognitive development of children aged 5 years and under indicated lower I.Q scores in iodine deficient children compared with iodine-replete children and concluded that iodine deficiency had a substantial impact on mental development (Bougma et al 2013). Less is known about the consequences of mild or moderate deficiency.

Research in the UK and Ireland has shown mild iodine deficiency in schoolgirls and pregnant women. (Vanderpump 2011) It is likely that many adult women may not be getting enough iodine, particularly in pregnancy. While there is as yet no available evidence of widespread thyroid hypofunction in the Irish obstetric population, one small Irish study observed levels suggestive of iodine deficiency in more than half (55%) of pregnant women, with a defined seasonal variation (Nawoor et al 2012).

7.5.1 Requirements

To ensure healthy thyroid function throughout pregnancy, adequate iodine intake is needed in the months prior to conception to ensure good thyroid stores. Following the National Healthy Eating Guidelines would be sufficient for most women to meet their iodine requirement preconception and during pregnancy. Including 2-3 servings of milk or yogurt daily and eating white fish once a week is recommended. Recent reviews have found insufficient data to reach any meaningful conclusions on the benefits and harms of routine iodine supplementation in women before, during or after pregnancy (Harding et al 2017). However, supplementation is advised for women who do not consume dairy foods or fish. As too much iodine has potential

to cause harm, only a multivitamin supplement designed for pregnancy containing 200 micrograms iodine is recommended.

7.5.2 Sources

Iodine is found in a range of foods, the richest sources being fish and dairy products. While seaweed is a concentrated source of iodine, it can provide excessive amounts and should be eaten in moderation.

The actual amount of iodine in food varies according to the iodine content of the soil, farming practice, fish species and season, making it difficult to accurately gauge iodine content per portion. In Ireland and the UK, milk and dairy products are the main sources of iodine for most people. Research in the UK has shown that organic milk has a 35-40% lower iodine content than conventional milk.

Pregnancy multivitamins currently available on the Irish market contain supplemental iodine between 100 and 200 micrograms, with the most widely available brands meeting 100% of requirements for pregnancy and lactation.

7.5.3 Multi-fetal Pregnancy

There is no specific recommended level of iodine for multiple pregnancy. Diets which include intakes of dairy foods and white fish sufficient to meet calcium requirements will also provide iodine. Where women follow restrictive diets for whatever reason, a pregnancy multivitamin daily is a practical recommendation.

7.5.4 Lactation

Iodine is a normal mineral in breastmilk that is essential for the infant's thyroid. The amounts of iodine in breastmilk vary with maternal iodine intake. Infant requirements are estimated to be 15 micrograms/kg daily in full-term infants and 30 micrograms/kg daily in premature infants (Ares, 2008). European research indicates that in iodine-sufficient areas, unsupplemented mothers excrete sufficient amounts of iodide in breastmilk, and routine supplementation is not necessary. (Gonzalez- Iglesesas 2012)

8.0 Clinical Guidelines on Hydration

Water is essential for all bodily functions, in particular thermoregulation. A water intake which balances losses and thereby assures adequate hydration of body tissues is essential for health and life (EFSA, 2010). Dehydration can result in constipation, headaches, lethargy and increased frequency of urinary tract infections. Fluid balance is generally self-regulated and managed without conscious involvement. Estimating requirements becomes vital within clinical settings for women who are unwell and not able to eat or drink liberally (Vivanti, 2012).

Poor hydration is a concern particularly among women experiencing hyperemesis gravidarum, a severe form of nausea and vomiting in pregnancy. Additional healthcare professional support, including referral to a dietitian, should be given to a woman with hyperemesis gravidarum to ensure her hydration status is maintained throughout pregnancy. HSE/RCPI guidelines for the management of hyperemesis gravidarum are available.

8.1 Requirements

Water requirements change depending on individual and environmental factors. Historically, it has been estimated in various ways from mL/kcal to mL/kg (Vivanti, 2012). Under ordinary circumstances, a reasonable estimate can be derived from 1 ml of water required for each 1 kcal of energy consumed (NRC, 1989). The EFSA suggest adequate intake for pregnant women to be that of non-pregnant women (2000 ml/day), plus an increase of 300 ml/day based on increased energy requirements. Therefore the recommended adequate fluid intake during pregnancy is 2,300 ml/day (EFSA, 2010).

Requirements increase in warmer ambient temperatures and with physical activity. Thirst may not be a reliable indicator of adequate hydration as mild dehydration triggers the sensation of thirst. A woman can be advised to monitor the colour of her urine as a practical indicator of hydration. Encourage women to drink to maintain pale, straw-coloured to transparent yellow urine with urination frequency of minimum 3-4 times per day (McKenzie, 2017).

8.2 Sources

Fluid requirements can be met with water from food and fluids, as well as oxidative processes in the body. Water is recommended as the main source of fluid for the general population as it does not contribute to dental caries or excessive weight gain. This advice does not change for pregnant women (FSAI, 2019).

8.3 Lactation

Estimates for adequate water intakes for lactating women are based on recommended intakes for women and additional water losses in breast milk production. This equates to 600-700 mL/day above the adequate intake for non-lactating women of the same age (EFSA, 2010).

9.0 Clinical Guidelines on Food Safety

Practicing food safety is important during pregnancy to reduce exposure to toxicological substances and pathogens which may cause harm to the woman and fetus. Table 10 provides a summary of toxicological agents, pathogens and sources women must be advised to avoid during pregnancy and lactation.

9.1 Toxicological substances

Summary recommendations:

Table 10: Toxicological substances and precautions in pregnancy and lactation

Substance	Reason for avoidance	Recommended upper limit (UL) and precautions	Sources
Caffiene	Stimulant	≤200mg Maximum 2 – 4 cups tea, 2 cups instant coffee, 1 filtered coffee a day	Coffee, tea, fizzy drinks, chocolate and medications
Alcohol	Teratogenic	Unknown – Avoid in pregnancy	Wine, beer, spirits, some medications and herbal tinctures
Mercury	Toxin	90-100 µg MeHg (2 cans Tuna or 1 tuna steak avoid other large fish)	Large fish high in food chain Shark, swordfish, marlin
Vitamin A (retinol equivalent)	Teratogenic	≤3000 µg	Liver, paté, some Supplements
Biotoxins	Neurotoxins	Not destroyed with heating or cooking Total avoidance recommended in pregnancy	Clams, mussels, scallops
Toxoplasma gondii	Parasite	Hand washing and good hygiene; Wear gloves when gardening or changing cat litter and wash hands afterward	Cat faeces/litter

9.1.1 Caffeine

There is sufficient evidence to indicate a risk to the health of the unborn with excess caffeine in pregnancy (WHO, 2016). Caffeine is a mildly addictive stimulant and is found in coffee, tea (including green and white tea), cocoa, chocolate, soft drinks, medications such as cold & flu remedies, pain relief, chewing gum and kola nuts. Caffeine can freely pass across the placenta but cannot be broken down by

the placenta or the fetus. Evidence suggests that excess caffeine intake (>400mg per day) can increase the risk of miscarriage and sudden infant death syndrome and lower intakes, may negatively affect fetal growth (FSAI, 2011).

Caffeine can be transferred to infants via breast milk. Infants do not synthesize the enzymes required to breakdown caffeine until approximately 3 months of age. Infants ingesting excessive caffeine may have poor sleep and become irritable (FSAI 2011).

- Pregnant women are advised to limit caffeine to the maximum recommended intake of 200mg per day. This equates to 2-4 cups of tea **or** 2 cups instant coffee **or** 1 cup filtered/brewed coffee.
- Lactating women are advised to limit caffeinated drinks to no more than 2-3 cups daily (200-300mg caffeine).

It should be noted that the caffeine content in teas and coffees vary depending on the brand, brewing time and method. Also, tea and coffee bought in a café may be stronger than that made at home.

9.1.2 Biotoxins

Biotoxins are produced in certain circumstances by various species of marine algae and accumulate in molluscs such as clams, mussels, oysters and scallops (FSAI, 2019). These toxins cannot be deactivated or destroyed by cooking or heating and can lead to gastrointestinal illness, neurotoxicity, multiple organ damage and in some situations, death for the woman. Studies are lacking to assess the risks to the fetus. Animal studies indicate these toxins can cross the placenta, lead to neurological damage that can present as learning and memory deficits later in life (Maucher et al, 2007; Munday, 2013).

- Advise women not to eat clams, mussels and oysters during pregnancy and lactation as exposure to biotoxins may cause severe illness in the woman and potential damage to the fetus.

9.1.3 Mercury

Mercury is a cumulative neurotoxin that is present both naturally in the environment and as a result of disposal of waste or releases from industrial activities. Excessive dietary mercury intake is mainly from large, predatory fish that are high in the food chain. Mercury readily crosses the placenta and fetal levels have been found to be higher than maternal levels (Ding *et al* 2013). Exposure to high levels of mercury can lead to significant neurological and behavioural disorders. Even lower levels of exposure can lead to adverse effects on neurological, cardiovascular and immune system functions (Karagas *et al* 2012).

- The advice for both pregnant and lactating women is to avoid intake of large predatory fish: shark, swordfish, ray and marlin. Tuna should be limited to one fresh steak per week or two 240g (8oz) tins per week.

9.1.4 Vitamin A

Pre-formed vitamin A (retinol equivalent) may be teratogenic at high doses (Hathcock *et al*, 1990). The maximum upper limit of pre-formed vitamin A, based on the risk of hepatotoxicity and teratogenicity, is 3000 micrograms or 3000 retinol equivalents (RE)/day (EFSA, 2006 & 2018). By contrast, precursors to vitamin A, beta-carotene and other carotenoids, pose no risk during pregnancy. The population reference intake for pregnant women is 700 micrograms per day (EFSA, 2015).

- Pregnant women are advised to avoid concentrated food sources of pre-formed vitamin A such as offal, liver and liver containing foods such as pâté.
- Women are advised to avoid dietary supplements (including fish liver oils) containing pre-formed vitamin A. Supplements containing beta-carotene as the sole source of vitamin A, which are used in many pregnancy-specific supplements, are suitable.

9.2 Food borne illness

Table 11: Summary sources and precautions of foodborne illness in pregnancy

Food	Reason for avoidance	Recommendation	Sources
Raw egg	Food borne disease (Samonella)	Thoroughly cooked eggs or dishes and desserts made with egg that are thoroughly cooked	Raw or partly cooked eggs, dishes containing part cooked eggs, homemade mayonnaise, custard or cheese cake made with raw fresh egg
Unpasteurised Dairy products	Food borne diseases	Avoid	All animal milk, cheese and yogurt which have not been pasteurised
Raw meat	Food borne disease (Toxoplasmosis)	Cook well Prevent cross contamination by storing raw meat/juices (bottom shelf) and ready-to-eat foods (upper shelves) separately in the refrigerator	Undercooked meat, burgers, BBQ
Raw Fish	Food borne disease	Avoid	Sushi, undercooked shellfish, cold smoked salmon
Mould ripened cheese	Food borne disease	Avoid or eat when cooked	Brie, camembert, gorgonzola, Danish blue and Roquefort.
Inappropriately prepared or stored food	Food borne disease	Hand hygiene and safe food preparation see FSAI/ safefood	All raw, cooked, ready-to-eat, reheated, stored foods

9.2.1 Safe Food Preparation

Food poisoning is caused by eating foods contaminated by either bacteria, viruses or parasites. Foods can become contaminated at any point during handling, storage or cooking. *Listeria monocytogenes* is a bacterium that is found in water and soil. Listeriosis is the illness that can result from ingestion of listeria from contaminated food. It can increase the risk of miscarriage, stillbirth, neonatal death and premature death. Listeria can be found in uncooked meats, uncooked vegetables, unpasteurised milk produce and processed foods. Listeria is killed by pasteurisation and cooking.

Toxoplasma gondii is a parasite, which can be found in raw and undercooked meat, unpasteurised goats milk, soil, cat faeces and untreated water. Toxoplasmosis, the resulting infection can be difficult to diagnose, as many patients do not exhibit any symptoms. If infection occurs during pregnancy, the parasite can be transmitted to the fetus, which causes congenital toxoplasmosis. The risk of transmission to the fetus is higher as the pregnancy progresses (Dunn, D *et al* 1999). Clinical manifestations of congenital toxoplasmosis if not treated include neurological deficits in early childhood or adulthood (Berrébi A *et al*, 2010).

To reduce the risk of food poisoning the following tips should be followed **during pregnancy and lactation**:

Handling and hygiene:

- Set fridge to 4ºC or lower
- Set freezer to 18ºC or lower
- Buy cold or frozen food at the end of shopping trip
- Keep food leftovers in the fridge and use within two days
- Wash hands, utensils and preparation surfaces well after handling raw meat.
- Always keep raw and cooked meat separate
- Reheat leftover meals to internal temperature of 70°C before consuming.

Meat, poultry and fish

- All meat poultry, fish, crab and lobster must be thoroughly cooked to internal temperature of 75°C before eating. This includes: cold cured meats such as pepperoni, salami, prosciutto, chorizo smoked fish (Avoid raw fish sushi)
- Avoid pâtés and molluscs (clams, mussels, oysters and scallops), both cooked and raw/cold.

Eggs

- Cook eggs until the white and yolk are solid.
- Pregnant women are advised not to consume foods in which raw eggs have been used: Homemade mayonnaise or aioli, Mousse, Cheesecake, Tiramisu

Fruit and vegetables

- Wash all fresh fruit and vegetables well prior to consumption to remove any traces of soil and visible dirt.
- These vegetables must be cooked thoroughly: Sprouts such as alfalfa, radish, mung bean and clover.

Dairy: milk, cheese and yogurt

- Consume only pasteurised or UHT (ultra-heat treated) milk and milk based produce.
- Avoid any unpasteurised milk (including goats and sheep's milk) and any products made using unpasteurised milks e.g. cheeses and yogurts.
- Avoid mould-ripened soft cheeses with a white rind unless thoroughly cooked: brie and camembert, soft blue veined cheeses e.g. gorgonzola, Danish blue and Roquefort. These cheeses can be eaten safely, cold or cooked, **during lactation**.
- All hard cheeses are safe to eat during pregnancy and lactation.
- Pasteurised soft cheeses, which are not mould-ripened as stated above, are also safe to consume e.g. cottage cheese, mozzarella, feta, halloumi, and ricotta.

For more information on general food safety guidance, see FSAI Healthy eating, food safety and food legislation
https://www.fsai.ie/science_and_health/healthy_eating.html for more details.
And **safefood.eu** https://www.safefood.eu/Food-safety.aspx

10.0 Specific Diets

- Refer pregnant women who require therapeutic diets to a dietitian. For example, women with:
  - coeliac disease
  - pre-existing type 1 and 2 diabetes
  - phenylketonuria
  - cystic fibrosis
  - anaemia
  - post-bariatric surgery
- Women with chronic disease will ideally have had dietetic input as part of their preconception care and will continue to have input from their multidisciplinary team as part of their obstetric management.

11.0 Allergies

- There is insufficient evidence to suggest that avoiding allergenic foods during pregnancy and lactation can protect an infant from developing allergies.
- It is not recommended that women avoid potentially allergenic foods during pregnancy unless she herself is allergic to a specific food. If the pregnant woman herself has a food allergy, care should be taken that she does not consume that specific allergen.
- Women who avoid food groups, such as dairy, due to allergy or intolerance are at risk of inadequate intake of nutrients. A referral to a dietitian is warranted in these cases.

For more information on food allergy treatment and avoidance see the Irish Food Allergy Network (IFAN) website: http://ifan.ie/.

12.0 Hospital Equipment and Facilities

- All women must have an accurate weight and height measurement taken at their booking antenatal visit.
- The centre must ensure equipment is available in a discrete area and calibrated as per manufacturer instructions to accurately record measurements.
- Best practice dictates that a digital weighing scale and a wall-mounted stadiometer (height measure) are used.
- When necessary nutrient deficiency should be diagnosed or monitored through appropriate blood tests. Hospitals should have access to phlebotomy and laboratory testing.

13.0 Provision of Information on Best Practice for Infant Feeding

- It is the responsibility of all healthcare professionals to promote best practice for infant feeding.
- The National Infant Feeding Policy for Maternity and Neonatal Services and local implementation policy can be found here: https://www.breastfeeding.ie/Resources/Health-professional/Infant-Feeding-Policy-for-Maternity-Neonatal-Services-2019.pdf
- Information and support around breastfeeding should be given ante-natally, as it has been shown that many women make the decision on whether or not they will breastfeed before the birth of their infant (FSAI, 2011).
- Pregnant women should be educated during this time on the many benefits breastfeeding offers the mother and her infant including the health benefits in both short-term and throughout later life.

14.0 Implementation Strategy

- Distribution of guideline to all members of the Institute and to all maternity units.
- Implementation through National Women and Infants Health Programme.
- Distribution to other interested parties and professional bodies.
- Encourage Making Every Contact Count training
- Education or updates of staff in maternity hospitals by local dietitians.
- Encourage training on Mychild via HSEland.
- Education or updates of staff in maternity hospitals and universities by local dietitians.

15.0 Key Performance Indicators

Standard key performance indicators

Many KPI's are measurable though the MNCMS system or local hospital maternity booking system (K2). The following KPI's should be collected and audited on a regular basis as part of standard care and hospital metrics in all maternity units.

1. **Key recommendation**: *"All women should have their weight checked and BMI calculated at the first antenatal visit, ideally in the first trimester. BMI checks at the booking visit should be used as a screening mechanism for those at increased risk."*

   Suggested KPI: Number/ proportion of women with weight and height and BMI at booking. GDM screening and anaesthetic clinic review should be provided as appropriate based on local policy for those with higher BMI's.

2. **Key recommendation**: *"Refer women with a BMI <17kg/m^2 to a dietitian"*

   Suggested KPI: Number of women with BMI< 17kg/m^2 referred to the dietitian.

3. **Key recommendation**: *"Antenatal appointments offer an opportunity to utilise the brief intervention model, outlined in the Making Every Contact Count Framework. Pregnancy is a time when women are keen to receive more information about healthy lifestyle interventions and are motivated to make positive choices. The frequent contact between pregnant women and the healthcare team at antenatal visits may be utilised to support patients to make lifestyle behaviour changes that may impact on weight gain, with a particular focus on physical inactivity and unhealthy eating."*

   Suggested KPI: Number of documented "Making Every Contact Count" records on MNCMS

4. **Key recommendation:** *"All women who may possibly become pregnant within the next three months, whether intentionally or not, are advised to take oral FA (FA) 400 micrograms daily to prevent neural tube defects (NTDS). After the first trimester and during breastfeeding, all women are advised to take FA 400 micrograms to meet the World Health Organization's recommended daily intake for pregnancy and breastfeeding."*

   Suggested KPI: Number of women on folic acid supplementation at booking

Additional key performance indicators

Other KPI's should be collected and documented in the patient's record. They will require audit which is not directly available from hospital summary metrics. Audit

to review a proportion of patient records can be conducted on a regular basis to monitor local implementation of the guideline.

1. **Key recommendation**: "*Women should be encouraged to achieve a healthy weight before conception to prevent associated complications. Weight loss in the postnatal period before subsequent pregnancies is an effective strategy for improved outcomes. Postnatal weight loss in overweight and obese women should be encouraged and where available onward referral to community dietetics should be provided*."

   Suggested KPI: Proportion of women with high BMI referred to community on discharge. This can be documented on discharge letter/ summary. Patient's GP can refer to the community dietitian the hospital should recommend this to GP.

2. **Key recommendation**: "*During pregnancy, a supplement containing 16-20mg of iron in addition to a balanced diet has the potential of reducing incidence of anaemia in the healthy population."*

   Suggested KPI: Proportion of women on multivitamin or supplement containing 16-20mg iron

3. **Key recommendation**: "*Women suspected of iron deficiency should have a full blood count (FBC) and, if possible, check serum ferritin. The treatment for iron deficiency anaemia is oral iron supplementation."*

   Suggested KPI: Number of women with iron deficiency anaemia

4. **Key recommendation**: "*All pregnant women in Ireland should take a supplement containing 10micrograms (400 IU) vitamin D_3 per day."*

   Suggested KPI: Proportion of women on 10micrograms (400 IU) vitamin D_3

16.0 Qualifying Statement

These guidelines have been prepared to promote and facilitate standardisation and consistency of practice, using a multidisciplinary approach. Clinical material offered in this guideline does not replace or remove clinical judgment or the professional care and duty necessary for each pregnant woman. Clinical care carried out in accordance with this guideline should be provided within the context of locally available resources and expertise.

This guideline does not address all elements of standard practice and assumes that individual clinicians are responsible for:

- Discussing care with women in an environment that is appropriate and which enables respectful confidential discussion.
- Advising women of their choices and ensure informed consent is obtained.
- Meeting all legislative requirements and maintaining standards of professional conduct.
- Applying standard precautions and additional precautions, as necessary, when delivering care.
- Documenting all care in accordance with local and mandatory requirements.

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Appendix 1:

Useful Websites

HSE Nurture Programme
https://www.hse.ie/eng/health/child/nurture/intro.html

Food Safety Authority of Ireland website:
http://www.fsai.ie/

HSE Health Promotion website:
http://www.healthpromotion.ie/

Safe food website:
http://www.safefood.eu/

The Irish Nutrition and Dietetic Institute (INDI) website:
https://www.indi.ie/

Making Every Contact Count
https://www.hse.ie/eng/about/who/healthwellbeing/making-every-contact-count/about/about.html

HSE My Child

https://www2.hse.ie/my-child/

HSE Land

https://www.hseland.ie

Irish Food Allergy Network

http://ifan.ie/

Appendix 2:

Daily macronutrient requirements for pregnant and lactating women

	1st Trimester	2nd Trimester	3rd Trimester	Lactation
Energy	Additional 0-85 kcal/ day	Additional 260-340 kcal/ day	Additional 450 - 500 kcal/ day	Additional 500 kcal/ day
Carbohydrate	175 g/ day minimum	175 g/ day minimum	175 g/ day minimum	210 g/ day minimum
Protein	Additional 1g/ day	Additional 9g/day	Additional ≤28g/day or one extra serving from food pyramid	Additional 19g/day or one extra serving from food pyramid
Fat	Additional 700-1400mg/week DHA	Additional 700-1400mg/week DHA	Additional 700-1400mg/week DHA	Additional 700-1400mg/week DHA

Appendix 3:

Daily micronutrient requirements for pregnant and lactating women

	1st Trimester	2nd Trimester	3rd Trimester	Lactation
Iron	16 milligrams	16 milligrams	16 milligrams	16 milligrams
Folic acid	400 micrograms	400 micrograms	400 micrograms	400 micrograms
Calcium	1000 milligrams	1000 milligrams	1000 milligrams	1000 milligrams
Vitamin D	10 micrograms (400 IU)	10 micrograms (400 IU)	10 micrograms (400 IU)	10 micrograms (400 IU)
Iodine	200 micrograms	200 micrograms	200 micrograms	200 micrograms