### Goal:
To briefly review the role of nutritional supplementation in supporting overall wellbeing during pregnancy.

### Objectives:
Following the successful completion of this module, the healthcare professional will be able to:

- List the risk factors resulting in the need for supplementation with vitamins and minerals in pregnancy;
- Discuss the importance of omega-3 and -6 intake during pregnancy;
- Describe the role of nutrition and nutritional supplements in preventing oxidative stress; and
- Identify and discuss the unique nutritional needs during pregnancy and lactation.

### Synopsis

“Low birth weight, small-for-gestational age (SGA), preterm birth, stillbirths, perinatal and neonatal mortality are important adverse outcomes of pregnancy. The incidence of low birth weight in developing countries varies from 6-30%, and at least one-third of these are small for gestational age, especially in settings with high rates of maternal under-nutrition. Small for gestational age (SGA) babies are those whose birth weight lies below the 10th percentile for a particular gestational age.

Vast majority of these are due to foetal growth problems that occur during pregnancy, including intrauterine growth restriction (IUGR). Full term SGA infants may not have complications related to organ immaturity like those of pre-term infants of similar size, but are at an increased risk of stillbirth and perinatal/neonatal mortality due to perinatal asphyxia, meconium aspiration and hypoglycaemia. Women of reproductive age, especially pregnant women in developing countries, are recognized to be at risk of multiple micronutrient deficiencies such as iron, folic acid, iodine, zinc, vitamins A and D, riboflavin, B6 and B12, with the likelihood of adverse effects on the mother and pregnancy outcomes.

Pregnancy represents a state of increased metabolic requirements, and intake of key micronutrients by pregnant women especially in developing countries is usually inadequate. This inadequate intake and increased requirement further exacerbates the pre-existing maternal deficiency. Iron deficiency contributes to one of the largest prevalence of micronutrient deficiencies among pregnant women. For example, anaemia affects approximately 41.8% of all pregnancies globally, with iron deficiency accounting for half of the cases. Retrospective and observational studies have demonstrated a higher risk of maternal mortality in severely anaemic pregnant women, predisposing to death from haemorrhage and infections. Maternal iron deficiency anaemia also has adverse effects on birth outcomes including a greater risk of birth asphyxia, low birth weight, preterm delivery and lower Apgar scores.

Given the significant impact of deficiencies of key micronutrients during pregnancy, supplementation with multiple micronutrients during pregnancy may be a feasible public health strategy. One potential advantage of multiple micronutrients could be that they might have comparable benefits to iron-folate in reducing anaemia, and could also have additional benefits on intrauterine growth and outcomes in the neonatal period and infancy.”

13
1. Introduction

The philosophy that food can be health-promoting beyond its nutritional value is gaining acceptance within the public arena and among the scientific community, as mounting research links diet and food to disease prevention, treatment and improved physical and mental well-being.

For many people living in this day and age, a healthy balanced diet seems to be an unattainable goal. Modern day pressures such as a lack of time for proper meal planning and preparation result in a reliance on unhealthy fast foods for quick energy. The consequences are a steady accumulation of unwanted body fat, sub-optimal health and an increased risk for potentially life threatening diseases such as diabetes in both children and adults. Also insulin fluctuations caused by sugar laden foods such as chocolates, sweets, crisps, muffins, and cool drinks result in poor performance, lethargy, lack of concentration and a renewed craving for sugary food.

In spite of an abundant food supply in developed countries, people do not obtain sufficient quantities of essential nutrients from food. It is well understood that soils become depleted of essential minerals. The nutrient integrity of food has also been eroded through modern processing, transportation and the preoccupation of food producers with appearance and shelf life. These factors, combined with poor food choices and imbalanced diets contribute to an inadequate intake of vital nutrients. Nutritional supplementation is therefore essential in the modern world.

2. Role of nutrition and nutritional supplements

Like water, carbohydrates, fats, protein, vitamins and minerals are essential to life. They are therefore considered nutrients, and are often referred to as micronutrients simply because they are needed in relatively small amounts compared with the four basic nutrients.

Although a balanced diet should cater for the average vitamin and mineral requirements, some people need to supplement their diets. People who are active and exercise; those who are under great stress, on restricted diets, or mentally or physically ill; women who take oral contraceptives, are pregnant or lactating; those on medication; those who are recovering from surgery and injury; smokers and those who consume alcoholic beverages all need higher than normal amounts of micronutrients. A diet that lacks essential nutrients over a long period of time leads to a greater risk of degenerative disease.

Micronutrients contribute to good health by regulating the metabolism and assisting the biochemical processes that release energy from digested food. There is a cooperative action between certain vitamins and minerals, which work as catalysts, promoting the absorption and assimilation of other vitamins and minerals. Correcting a deficiency in one vitamin or mineral requires the addition of others, not simply replacement of one in which there is a deficiency.

Antioxidants can neutralize the cell-damaging effects of free radicals. Furthermore, people who eat fruits and vegetables (good sources of antioxidants), have a lower risk of heart disease and some neurological diseases, and there is evidence that some types of vegetables, and fruits in general, protect against a number of cancers. There is also evidence that antioxidants might help prevent other diseases such as suppressed immunity due to poor nutrition, neurodegeneration, and macular degeneration.

Some experts have suggested that in order for antioxidants to be effective and beneficial, a person must consume them on a regular basis over a period of time. In order to protect a body against oxidative stress, several antioxidant defence systems have been developed by all living organisms - these defence mechanisms depend on minerals for proper functioning. The major enzymatic antioxidant defence systems in the body are superoxide dismutase, which requires copper, zinc and manganese; glutathione peroxidase is another enzymatic antioxidant defence system requiring selenium, with catalase which requires iron.

Free radicals are normally present in the body in relative small amounts. An excess can be produced by different factors such as exposure to radiation (sun rays or medical x-rays), exposure to environmental pollutants such as vehicle exhaust fumes and tobacco smoke, exposure to medicines, toxins, chemicals and foods high in fat and unhealthy oils. Reactive oxygen species (ROS) need to be maintained in the body and include under normal conditions hydrogen peroxide and hydroxyl radicals.
2.1 Nutrition during pregnancy and lactation

“At the time of conception, maternal nutritional status is an important determinant of embryonic and foetal growth. Placental and foetal growth is most vulnerable to maternal nutrition status during the preimplantation period and the period of rapid placental development, which occurs during the first few weeks of development typically before pregnancy has been confirmed. Most organs form 3-7 weeks after the last menstrual period and any teratogenic effects may occur by this time. Evidence is emerging that a mother’s diet and lifestyle influence the long-term health of her children. Recent research suggests that inadequate levels of maternal nutrients during the crucial period of foetal development may lead to reprogramming within the foetal tissues that predisposes the infant to chronic illnesses in adulthood. A woman’s nutritional status is influenced by numerous variables including genetics, environment, lifestyle habits, the presence of disease or physiological stressors, and drug-toxicant exposures.

Nutritional assessment and recommendations are important components of preconception counselling. The key components of the nutrition care process include:

- A nutrition assessment, including analysis and interpretation of anthropometric data and adequacy and quality of dietary habits (including dietary supplements).
- A nutrition diagnosis, which will identify and label any nutrition-related problems or risk factors such as obesity or eating disorders.
- The nutrition intervention, at which time the individual’s dietary goals and plan of action are established and care is delivered with the emphasis on appropriate weight gain, consumption of a variety of foods, etc.
- Nutrition monitoring, evaluation, and referrals to dieticians occur as needed, depending on the individual’s needs.

Although in the general population a healthy balanced diet should largely obviate the need for vitamin and mineral supplementation, pregnancy and lactation create extra nutritional demands that, for some individuals, may make supplementation advisable. During pregnancy and especially while breastfeeding, a mother’s nutritional requirements change significantly and the recommended nutrient intake of vitamins and minerals increases. Maternal metabolism is altered by hormones that mediate the redirecting of nutrients to the placenta and mammary glands as well as the transfer of nutrients to the developing infant.

Then there are challenges like morning sickness, constipation and heart burn. To enable the body to cope with the pregnant state, it is imperative to get sufficient nutritional support from food. However, eating regular and balanced meals is sometimes easier said than done. For babies to develop optimally during pregnancy they need the right nutrients. After birth, breast milk becomes the main source of nutrients and is supplied through the consumption of breast milk (ideally a new mother should breastfeed for 1 year). So it is very important that mothers get the nutritional support to allow babies to develop optimally before birth, as well as to ensure a big enough supply of high quality mother’s milk after birth.

Nutritional shakes provide advanced nutritional support to expectant mothers and their babies. These are usually high in energy (contain fructose), protein for tissue development (skim milk powder) and fibre. In addition, these shakes contain a wide spectrum of vitamins and minerals, and because these powders are low in fat, they do not cause nausea. The ginger and vitamin B6 in some of these shakes may also help to counter nausea.

2.2 Risk factors resulting in the need for supplementation with vitamins in pregnancy include:

- Poor public awareness and lack of education results in lack of knowledge about adequate prenatal nutrition and care;
- Cultural beliefs with specific nutritional traditions and dietary taboos result in micronutrient deficiency having potential adverse consequences for both mothers and new-born infants;
- Pregnancies are mostly unplanned in the western population, resulting in minimal time for folic acid reserve build up;
- Many people in developing countries exist on monotonous cereal- or legume based diets and has limited access to animal products or a variety of fruit and vegetables; and
Maternal micronutrient deficiencies may also exist due to gastro-intestinal disorders such as chronic diarrhoea resulting in malabsorption of nutrients.

### 2.3 Pregnancy-related changes posing a risk for micronutrient deficiencies include:

- Kidney function changes to handle the clearance of both foetal and maternal metabolic waste, resulting in increased urinary excretion of water-soluble vitamins (e.g. folate); and
- By the third trimester, blood volume will have increased by 35-40% over the non-pregnant state, largely because of a 45-50% expansion of plasma volume and a 15-20% expansion of red blood cell mass. This then explains the increased need for iron, since it is metabolised in the production of red blood cells.

### 2.4 Nutritional status during pregnancy

The nutritional status of a pregnant woman affects the outcome of her pregnancy; this is especially true in respect to the infant’s birth weight and the risk of long term health complications (see figure 1). The recommended intake for 13 of the 21 essential micronutrients increases during pregnancy and includes seven vitamins, five minerals and choline.2

There is increasing support that supplementation of specific vitamins, minerals and omega-3 fatty acids can have a positive impact on maternal health in terms of the prevention of pre-eclampsia, miscarriage, preterm birth, low birth weight, gestational diabetes and also on the long-term health of the baby.3 All nutrients are important during development, but folate, vitamin B12, iron, and zinc are especially important due to their key roles in the synthesis of DNA, new cells and their ability to prevent certain neonatal diseases.

**FIGURE 1: Projected deaths by cause for high-, middle- and low-income countries**

Lactation and pregnancy are two phases during which food consumption of the mother can interact with the physiology of the baby.4 Several studies have explored the link between micronutrient deficiencies and growth failure.5 Multiple micronutrient deficiencies are very common, usually resulting from poor-quality diets - the most prevalent micronutrient deficiencies are amongst others iron, vitamin A, zinc, vitamin B12 and vitamin D (mainly due to a low intake of animal source foods).6

It is thus imperative that mothers get the nutritional support to allow babies to develop optimally before birth, as well as to ensure a big enough supply of high quality mother’s milk after birth. In general, infants will consume only about half of their recommended Adequate Intake (AI) of the “priority” micronutrients if their mother is depleted.6
2.4.1 Vitamins

**Vitamin A** helps to keep skin and tissue linings healthy, promotes healthy vision and helps bones and teeth develop properly. Vitamin A deficiency impacts on vision, in particular causing irreversible corneal damage and blindness; it is also a contributing factor to childhood mortality from measles and diarrhoea. Primary sources include liver and other organ meats, fish liver oils, fatty fish, whole milk, butter and egg yolks, and vitamin-fortified cereals.

Vitamin A is a fat-soluble vitamin found in several forms. Vitamin A found in foods that come from animals (liver, whole milk) is called preformed vitamin A. It is absorbed in the form of retinol, which is made into retinal and retinoic acid (other active forms of vitamin A) in the body. Vitamin A that is found in fruits and vegetables is called provitamin A carotenoid, which is made into retinol in the body. There is also a synthetic analogue (13-cis retinoic acid) isotretinoin (Accutane; Roche Pharmaceuticals, Nutley, NJ), a medication used to treat severe, cystic acne, and related dermatoses. Adequate vitamin A is essential for proper visual functioning, foetal growth, reproduction, immunity, and epithelial tissue integrity. Because vitamin A is lipid soluble, it crosses the placenta easily and has a long half-life. Although normal foetal development requires sufficient vitamin A intake, very high levels of preformed vitamin A (retinoic acid) supplementation has been associated with miscarriage and birth defects that affect the central nervous system and craniofacial, cardiovascular, and thymus development.

During pregnancy, evidence in humans suggests that more than 10,000 IU of vitamin A per day may be teratogenic, resulting in cranial/neural crest defects. However, other studies have shown that periconceptional vitamin A exposures greater than 10,000 IU/day were not associated with increased risk for cranial neural crest defects or neural tube defects. Although animal data clearly show that high dose vitamin A is teratogenic, such data are difficult to obtain in humans as human clinical trials are not ethically possible. Beta-carotene, a precursor to vitamin A has however not been shown to be teratogenic. Vitamin A also appears to be protective in pregnant women with human immunodeficiency virus/acquired immunodeficiency syndrome. There is growing evidence from clinical trials in developing countries that vitamin A may protect against maternal morbidity, although more research is needed.

**Vitamin D** is essential for the maintenance of calcium homoeostasis and regulation of bone mineralization. Deficiency in children can lead to rickets, and in adults it is related to osteomalacia, osteoporosis, and risk of fractures. Vitamin D deficiency is becoming more prevalent today, especially since sunlight exposure has decreased (due to the risk of skin cancer and indoor playing). Vitamin D-fortified milk, egg yolks, liver, tuna, and other cold-water fish are good dietary sources.

Premature infants may need additional vitamin D to support their especially rapid growth and bone development. Studies of pregnant women attending antenatal clinics have found a disturbing frequency of vitamin D deficiency in some communities. Women at increased risk include those with reduced sunlight skin exposure e.g. veiled women, those who use sunscreen on a regular basis and dark-skinned women. These patients should be supplemented with additional vitamin D during pregnancy. Lowered concentrations of vitamin D during pregnancy are suggested to be related to low bone mineral content (BMC) in offspring. If this association is true, it is relevant to public health, as up to 70% of otherwise healthy pregnant women have insufficient concentrations (most commonly defined as lower than 50.0 nmol/L) of 25-hydroxyvitamin D (25[OH]D). Lawler and co-workers (2013) did a large prospective study to investigate whether there is an association between maternal 25(OH)D concentrations in pregnancy and offspring BMC. They also aimed to assess whether the association is mediated by the child’s own 25(OH)D concentration, which relates directly to BMC; additionally, they tested the hypothesis that the third trimester is a sensitive period for bone mineralisation by 25(OH)D. They however found no relevant association between maternal vitamin D status in pregnancy and in offspring BMC in late childhood.

The optimal dose of vitamin D for the preconceptual period and during pregnancy is unknown. Observational studies and vitamin D supplementation trials among pregnant women at high risk of vitamin D deficiency showed improved neonatal handling of calcium with improved maternal vitamin D status. Results concerning the effects of vitamin D on maternal weight gain and foetal growth in these high-risk
populations are conflicting and inconclusive.\textsuperscript{23,24} Despite taking prenatal vitamins, vitamin D deficiency has been demonstrated in pregnant women.\textsuperscript{25}

**Vitamin C** not only supports the immune system, but also helps maintain capillaries, cartilage, bones and teeth. Citrus fruits provide substantial amounts of vitamin C. Having a low intake of vitamin C may be associated with complications in pregnancy such as pre-eclampsia, anaemia and having a small baby. A Cochrane review of trials found that there is not enough good evidence to say if supplementing women with vitamin C during pregnancy prevented the baby dying or being born small. Vitamin C supplementation was associated with a moderate increase in the risk of preterm birth, although further research is required. Vitamin C supplementation may help to prevent women developing pre-eclampsia during their pregnancy, although more research is needed.\textsuperscript{15}

The **B-vitamins** work synergistically as a complex. Low B12 intake can result in anaemia and improper nerve function. This B vitamin is also necessary for fatty acid and DNA synthesis. All animal products provide ample amounts of this nutrient, but is entirely absent from plant foods. Vegetarians and vegans should therefore supplement with vitamin B12 during pregnancy and lactation.

**Folic acid (folate)** works with B12 to synthesize DNA; folic acid deficiency can also result in anaemia. Fresh fruit and vegetables provide high levels of folic acid. In October 2003, South Africa embarked on a program of folic acid fortification of staple foods. They measured the change in prevalence of Neural Tube Defects (NTDs) before and after fortification and assessed the cost benefit of this primary health care intervention conducted among 12 public hospitals in four provinces of South Africa. The study showed a significant decline in the prevalence of NTDs following folic acid fortification in South Africa and declines of up to 30.5% were observed.\textsuperscript{1}

The Department of Health (2003) has set the level of fortification of folic acid in wheat flour at 1.5 mg/kg and in maize meal at 2.21 mg/kg and it is well known that maize meal and bread are among the most widely consumed staple foods in South Africa, especially in the lower income groups. It is recommended that folic acid should be taken for a minimum of one month before conception and for the first 12 weeks of pregnancy. By getting adequate folate or folic acid daily (0.8 mg is recommended) before and during pregnancy the risk for NTDs can be reduced by 70%.\textsuperscript{12} Where there is an increased risk of NTD (e.g. anticonvulsant medication, pre-pregnancy diabetes mellitus, previous child or family history of NTD), or with an increased risk for folate deficiency (e.g. multiple pregnancies, haemolytic anaemia), a 5 mg daily dose should be taken.\textsuperscript{1}

**Choline**, often referred to as an unofficial member of the vitamin B family, is an important nutrient for cell membrane formation and maintenance. It is an important nutrient that helps brain cells develop properly - animal studies suggest that adequate choline intake during pregnancy has long-lasting effects on a baby’s ability to learn and remember, and may even provide some resistance to mental illness. Choline is the precursor to the neurotransmitter acetylcholine. Loss of cholinergic neurons is associated with impaired cognitive function, particularly memory loss and Alzheimer disease (AD). Brain atrophy and white-matter hyperintensity (WMH) are also associated with impaired cognitive function and AD.\textsuperscript{17}

Researchers have also discovered that getting enough choline during pregnancy can help protect a newborn against neural tube defects (much like folic acid does). Other benefits for mothers who have adequate choline include a reduced risk of breast cancer and lower levels of homocysteine. Homocysteine is an amino acid, one of the building blocks of protein, but too much homocysteine in the blood is associated with an increased risk of heart disease, cancer, and cognitive decline.

### 2.4.2 Minerals

**Magnesium** not only helps build bones and teeth, but it also plays a crucial role in the transmission of nerve impulses and supports muscle function as well as protein and DNA synthesis. Magnesium and potassium intake during pregnancy will also help with muscle cramping. Magnesium deficiency is rare, as it is easily obtained from a wide variety of foods such as green leafy vegetables, whole grains, meats, beans, nuts, seeds, soybeans and meat products. The toxicity associated with magnesium use is most common in people with compromised renal function taking antacids and symptoms include nausea, vomiting and bradycardia.
Calcium is another multi-functional mineral, and is the most abundant mineral in the human body. About 99% is concentrated in the bones and teeth, with the remainder being found in the soft tissues ensuring proper nerve and muscle function. Calcium works in conjunction with a number of other nutrients such as vitamin D, boron and magnesium to help build and maintain healthy bones and teeth. It also aids in blood clotting and maintains cell membranes.

Osteoporosis has its antecedents in childhood and the intake of calcium during pregnancy and childhood should therefore be increased. Currently the average dietary intake of calcium in children and adolescents are well below the recommended levels of adequate intake. Maintaining adequate calcium intake during childhood and adolescence is necessary for the development of peak bone mass, which may be important in reducing the risk of fractures and osteoporosis later in life. Good bone health requires satisfactory intakes of both calcium and vitamin D throughout life. Excellent sources of calcium include dairy products like milk, yogurt and cheese. Tofu that is processed with calcium salts is another excellent source. Collard greens, soy milk, turnip greens, kale, dried beans, peas and broccoli also provide calcium. If a woman avoids dairy in her normal diet (e.g. lactose intolerant) and does not consume alternative high calcium food (e.g. calcium enriched soya milk), calcium supplementation is recommended at 1000 mg/day.

Iodine deficiency is the single most important preventable cause of brain damage. In 2005 the World Health Organization estimated 2 billion people, 35% of the world population were iodine deficient. Iodine is necessary for the production of thyroid hormones, thyroxine, and triiodothyronine, and it must be provided in the diet. Inadequate iodine intake leads to inadequate thyroid hormone production and to a spectrum of disorders, iodine deficiency disorders, including abortion, stillbirth, mental retardation, cretinism, increased neonatal and infant mortality, goitre, and hypothyroidism. Iodine is readily transferred to the foetus, and the foetal thyroid concentrates iodine and synthesizes thyroid hormones by 10-12 weeks’ gestation. Iodine deficiency in pregnancy negatively affects the normal maturation of the developing foetal central nervous system, particularly myelination, and is responsible for cognitive impairment, permanent mental retardation, and in its most severe form, cretinism. Iodine deficiency disorders are among the easiest and least costly of all disorders to prevent. Adding a small amount of iodine in the form of potassium iodate or potassium iodide to dietary salt is effective for prevention. Salt iodization is the recommended, preferred strategy to control and eliminate iodine deficiency.

Sufficient dietary iodine throughout the life cycle, especially during the preconception period, can minimize the risk of iodine deficiency during critical, early foetal development. Studies of the impact of iodine supplementation specifically before pregnancy have not been done. Identification and treatment of iodine deficiency disorders before pregnancy is an effective preventive public health strategy. Recent research suggests that iodine supplementation is mandatory in areas of regional deficiency. Women who are pregnant, breast feeding or considering pregnancy should take an iodine supplement of 150 micrograms each day as it is important in neural development.

Iron demands of pregnancy and lactation are particularly pronounced due to the expanded red cell volume, blood loss around the time of delivery and the demands of the developing foetus and placenta. Iron supplementation will generally be recommended to pregnant women - a healthy adolescent female should look for a multivitamin containing 30 mg iron. All women should have their haemoglobin level checked at the first antenatal visit and again at approximately 28 weeks’ gestation.

Iron is an essential mineral for children. Iron-deficiency anaemia is the most common deficiency among children and has been shown to contribute to scholastic under-achievement and behavioural disturbances. Low iron levels have been linked to low birth weight, retarded physical growth and weight gain. Adolescent girls who have begun menstruating are at increased risk for iron-deficiency anaemia. Meat products (especially red meat, liver and other organ meats) are by far the best sources of iron. Heme iron, the organic variety of iron found in meat sources, is the most easily absorbed by the body. The iron derived from vegetable sources can be more difficult for the human body to process. In either case, consuming vitamin C along with sources of iron increases the iron's absorption.

Reproductive-aged women are at risk of iron deficiency because of blood loss from menstruation, poor diet, and frequent pregnancies. In a study of fertile women, only 20% had iron reserves of greater than 500 mg, 40% had iron stores of 100-500 mg, and 40% had virtually no iron stores. Potential foetal complications secondary to anaemia include spontaneous prematurity and intrauterine growth restriction.
The mechanism(s) by which this occurs are not clear. Prior to conception and during pregnancy, women should eat iron-rich foods (lean meat, poultry, and iron fortified cereals). Foods that inhibit iron absorption, such as wholegrain cereals, unleavened whole-grain breads, legumes, tea, and coffee, should be consumed separately from iron-fortified foods. The Centres for Disease Control and Prevention (CDC) recommends 18 mg/day for women and 27 mg/day for all pregnant women.37

There are several systematic reviews reporting the benefits of iron combined with folate prior to and during pregnancy. The Cochrane collaboration completed a systematic review on 20 randomized controlled trials of iron supplementation in pregnancy with normal haemoglobin levels (> 10 dL) at less than 28 weeks of gestation.36 Iron supplementation raised or maintained the serum ferritin level above 10 mg/L and reduced the number of women with low haemoglobin levels late in pregnancy. The reviewers however concluded that iron supplementation had no detectable effect on any substantive measures of either maternal or foetal outcomes.36

Zinc is another important micronutrient with major effects in the body; a deficiency contributes to growth failure, birth defects, premature delivery and susceptibility to infection.8,12 It is most easily consumed in meat, but other good sources for zinc include leafy green vegetables and pumpkin seeds.

Zinc is widely recognized for its critical roles in cell division, differentiation and function that are essential for tissue growth. Zinc-dependent enzymes, zinc-binding factors and zinc transporters are required in a variety of complex mechanisms during cell replication, maturation and adhesion, such as DNA and RNA metabolism, signal recognition and transduction, gene expression, and hormone regulation.38-40 Consequently, zinc is a key nutrient during embryogenesis, foetal growth and development, and mammary gland function for milk synthesis and secretion.

Severe zinc deficiency during pregnancy and lactation has devastating effects on pregnancy outcome, as shown in animal studies and in pregnant women with acrodermatitis enteropathica.41 Multiple foetal malformations, embryonic or foetal death, foetal growth retardation and life-threatening maternal complications during pregnancy and labour have been described. Severe zinc deficiency can also cause diarrhoea and a compromised immune function, mental disturbances and delayed bone function, and a decreased testicular size and function. Although severe zinc deficiency is rare worldwide, mild to moderate zinc deficiency is highly prevalent in pregnant and lactating women in several geographic regions.42 It has been estimated that 82% of pregnant women in the world have insufficient zinc intakes.43

Sub-adequate maternal zinc intakes may affect pregnancy outcomes and infant development. However, it is surprising to note that human observational studies have failed to find associations between poor maternal zinc status or intake and pregnancy complications, duration of gestation, and measurements of foetal growth and development. Donangelo and King (2012)44 hypothesized that zinc homeostatic adjustments during pregnancy and lactation improve zinc utilization sufficiently to provide the increased zinc needs in these stages and, therefore, mitigate immediate detrimental effects due to a low zinc intake. Increased needs can be met by increasing the dietary zinc intake, along with making homeostatic adjustments in zinc utilization. Potential homeostatic adjustments include changes in circulating zinc, increased zinc absorption, decreased zinc losses, and changes in whole body zinc kinetics. Although severe zinc deficiency during pregnancy has devastating effects, systematic reviews and meta-analysis of the effect of maternal zinc supplementation on pregnancy outcomes have consistently shown a limited benefit.44

2.4.3 Essential fatty acids

2.4.3.1 Omega-3 fatty acids

Omega-3 and omega-6 fatty acids are known as essential fatty acids (EFAs) as they can’t be synthesised by the body and must be obtained through the diet. EFAs are essential components of cell membranes. Cell membranes separate and absorb, secrete, excrete, and maintain a balance between the inner and outer part of the cell. An alteration in cell membrane function may be a central factor in cell injury and death.
EFAs are transformed into the hormone-like substance called prostaglandins. These are extremely active, short-lived compounds that require constant renewal and a good supply of EFAs. These two functions of EFAs alone account for a whole array of physiological functions.

The widespread importance of EFAs in so many essential functions within the body accounts for signs and symptoms that may be overt or chronically nagging such as tiredness, or more severe such as heart disease. Other more common symptoms include lacklustre energy, cracked nails, dry skin, dry lifeless hair, dry mucous membranes, tear ducts, mouth and vagina, constipation, depression, frequent colds, forgetfulness, difficulty in losing weight, mental health problems, water retention, premenstrual problems, and tingling in the hands and legs.

Prostaglandins are important for the regulation of blood pressure, blood clotting, inflammation in the body, allergy response, steroid production and hormone synthesis, heart, kidney, and gastrointestinal function. The above symptoms and signs are not exclusive to EFA deficiency and certainly other deficiencies may also be present that need to be considered.

The two essential long chain polyunsaturated omega-3 fatty acids are docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA). DHA is a building block of tissue in the brain and retina of the eye. It helps with forming neurotransmitters, such as phosphatidylserine, which is important for brain function. DHA is found in the retina of the eye and taking DHA may be necessary for maintaining healthy levels of DHA for normal eye function.

DHA plays a very important role during foetal development, early infancy, and old age. High concentrations of DHA are found in the brain and increases 300-500% in an infant's brain during the last trimester of pregnancy. Adding DHA to a pregnant mother's diet may be beneficial for the foetus's brain development. Omega-3 fatty acids are also of value for children with learning problems.

EPA and DHA also functions as a source of energy, it insulates the body against heat loss, prevents skin from drying and flaking, and cushions tissues and organs.

2.4.3.2 Omega-6 fatty acids

Omega-6, like omega-3 are essential fatty acids (EFAs) that must be obtained from either the diet or from nutritional supplements as the body can't make these nutrients that are required for body function. Both families (omega-3 and omega-6) are of particular interest in the modulation of inflammation, infection and tumour growth.

The omega-6 family (evening primrose oil, borage oil) contains linoleic acid. Linoleic is converted in the body to gamma-linolenic acid (GLA), which in turn is converted into dihomo gamma linolenic acid (DGLA). This is the pathway to prostaglandins of the series 1 type. Prostaglandins of the series 1 type prevent platelet stickiness, relax blood vessels, lower blood pressure, help maintain water balance in the body, decrease inflammation and pain, and improve immune function.

A less preferred pathway is the formation of arachidonic acid from DGLA and the formation of prostaglandins of the series II type together with inflammatory leukotrienes. This latter pathway is responsible for many of our inflammatory problems. Animal foods have a high content of arachidonic acid promoting the formation of series II prostaglandins and inflammation.

Omega 6 deficiency signs could include: high blood pressure, premenstrual stress, dry skin and eczema, dry eyes, arthritis and stiff joints, and being more prone to infections.

2.4.3.3 Research: EFA

There is mixed evidence for the efficacy of essential fatty acids such as fish oil against adverse pregnancy outcomes for mother and child during preconception and pregnancy. For example, epidemiological evidence suggests an association between fish intake and birth weight. Another study showed a positive correlation with low fish consumption in early pregnancy and increased risk for preterm delivery and low birthweight. A meta-analysis of six randomized controlled trials demonstrated that supplementation with
omega-3 fatty acids was associated with a significantly greater length of pregnancy than in control subjects; however, there was no evidence that supplementation influenced the percentage of preterm deliveries, the rate of low-birth weight infants, or the rate of preeclampsia. In a review, the results of several randomized clinical studies have indicated that supplementation with fish oils may lead to modest increases in gestation length, birth weight, or both. The Cochrane collaboration review of 6 clinical trials found women randomized to a fish oil supplement had a mean gestation that was 2.6 days longer than women allocated to placebo or no treatment. Birth weight was slightly greater in infants born to women in the fish oil group compared with controls. However, there were no overall differences between the groups in the proportion of low birth-weight or small-for-gestational-age babies.

2.4.4 Fibre and prebiotics

Increased fibre in the diet has shown to work effectively as treatment of several gastrointestinal conditions including irritable bowel syndrome, diverticulosis and haemorrhoids. Insoluble fibre absorbs water to a certain extent but mainly contributes to the bulking of stool, and thus allows quick passage of wastes through the digestive system and will thus assist with the constipation experienced by some pregnant women. Soluble fibre dissolves in water and forms a gel that binds the stool, it contributes little to stool bulk, and slows the passage of wastes through the digestive tract.

Prebiotics are short-chain carbohydrates that alter the composition/metabolism of the gut microbiota in a beneficial manner. Oligofructose, galacto-oligosaccharides and lactulose alter the balance of the large bowel microbiota by increasing bifidobacteria and lactobacillus numbers. The prebiotics are fermented by these bacteria thus yielding short-chain fatty acids which is concomitantly used by the cells of the gut as a source of energy.

2.5 Conclusions

The quality of a woman’s diet during pregnancy has an influence on positive foetal and maternal outcomes; therefore, a healthy balanced diet is important before as well as during pregnancy. Many women of childbearing age in South Africa do not maintain a healthy diet prior to, during, and after pregnancy. Not all women have financial or logistical access to a high-quality diet. Furthermore, several studies have shown that most women of reproductive age are not getting enough vitamins A, C, B6, and E, folic acid, calcium, iron, zinc, and magnesium in their diet. This underscores the importance of encouraging healthy eating behaviours early in a woman’s child-bearing years because improving dietary habits requires long-term supplement use, and physical activity efforts.

The purpose of multiple-micronutrient supplementation during pregnancy and lactation is thus twofold: to improve pregnancy outcomes by reducing pregnancy complications, reducing the risk of developmental and common birth defects and to improve breast-milk quality.
2.6 References


