CHAPTER - I

INTRODUCTION

It is a universally acknowledged medical truth that adequate nutrition before and during pregnancy has greater potential for a long term health of both mother and the child and it is important during the course of pregnancy (Singh et al., 2009). Poor foetal growth has been attributed to widespread maternal under-nutrition. Maternal nutrition is an important factor responsible not only for health of baby, but also for the baby’s long term growth (Jackson and Robinson, 2001). Deficiencies of vitamin A, and zinc are prevalent in pregnant women in developing countries. Supplementation during pregnancy can benefit mother and infant (Dijkhuizen et al., 2004).

Maternal plasma zinc concentrations start to decrease as early as 6 weeks of gestation and continue to decline until delivery. In pregnancy deficiency of zinc have been implicated in various reproductive events like infertility, pregnancy wastage, congenital abnormalities (Black, 2001), pregnancy induced hypertension and placental abruption, premature rupture of membranes, still birth as well as low birth weight (Pathak et al., 2001). Although it has been emphatically recognised that zinc supplementation also tend to decrease incidence of low birth weight (LBW) neonates (Kramer, 1987).

Zinc plays a critical role in normal growth and development, cellular integrity and many biological functions, including protein synthesis and nucleic acid metabolism (Vallee and Falchuk, 1993). It is present in more than seventy metalloenzymes including RNA
polymerase and thymidinokinase. Since all these are involved in cell division and growth, zinc is believed to be important for fetal growth and development. It has been proved that deficiency of zinc can adversely affect the pregnancy outcome.

Studies of pregnant women in African countries (Nigeria, Egypt, Zaire, and Malawi) have shown lower plasma zinc or hair zinc concentrations than in pregnant women from developed countries (Okonofu et al., 1990 and Kirksey et al., 1992). Also, several studies have reported that maternal plasma zinc decreases during pregnancy from 24-33 week of gestation (Perveen et al., 2002, Izquierdo et al., 2007 and Martin et al., 1998).

Zinc is essential for the normal growth and development of the fetus. Severe maternal zinc deficiency, as seen in acrodermatitis enteropathica, has been associated with spontaneous abortion and congenital malformations (Hambidge et al., 1975), whereas milder forms have been linked with low birth weight, intrauterine growth retardation and preterm delivery (Jameson, 1993).

Stumpy maternal zinc status during pregnancy or delivery has been made known coupled with a 3·5–7 fold increased risk for premature rupture of membranes, pregnancy induced hypertension, inefficient uterine contractions, prolonged or non-progressive labour, and maternal haemorrhage and infections (Sikorski et al, 1990 and Scholl et al., 1993).

For a long while vitamin A deficiency was known to be prevalent only in children but recent studies have shown that it is also very common during pregnancy (Katz et al,1995 and Vinutha et al., 2000). Vitamin A is also an essential micronutrient for immunity,
growth, reproduction, cellular differentiation, maintenance of epithelial surfaces, and vision. In developing countries, pregnant women are at a higher risk of developing vitamin A deficiency because of an increased demand for vitamin A by the developing fetus. Although animal studies demonstrate that vitamin A deficiency during pregnancy is connected with reproductive failure and high rates of mortality of offspring (Apgar et al., 1991) and few studies of early 1960s in India identified pregnancy as a vulnerable period for the development of vitamin A deficiency (Dixit et al., 1966 and Mandal et al., 1969). Various studies have however revealed a very high prevalence (11-30%) of vitamin A deficiency in pregnant women (Vinutha et al., 2000).

Recent, researchers have shown a very positive influence of vitamin A on plasma progesterone and estrogen levels during pregnancy (Panth et al., 1991). Since progesterone is responsible for healthy fetoplacental function, it is postulated that besides its confirmed role in cellular differentiation and morphogenesis, vitamin A may also have an indirect role in fetal growth and maturity (Azais et al., 2000) A pioneer study conducted by Burns et al. revealed that women with low and very low vitamin A levels before third trimester were more likely to deliver LBW infants than those with higher levels.

Maternal serum retinol concentrations fall during pregnancy, even in well nourished women. This is due to haemodilution and changes in proteins in serum, and not to a high fetal uptake of the vitamin. In fact, infant stores of retinol at birth are low and are relatively little influenced by the vitamin A status of the mother.

There has been renewed interest, in areas where the prevalence of vitamin A deficiency (VAD) is high, in the value of maternal vitamin A supplementation during pregnancy. It is now recognized that
there are several benefits of supplementation. The prevalence of vitamin A deficiency normally increases substantially as pregnancy progresses. Relatively recent surveys report on VAD prevalences in pregnancy is 8 to 16% in rural Nepal, 0.6 to 2.8% in Sri Lanka, and 1% in a national vitamin A survey in Bangladesh. Vitamin A deficiency is also coupled with a higher risk of maternal mortality and morbidity. For example, in Nepal, the death rate was about 26/1,000 for those pregnant women who reported vitamin A deficiency, compared to 3/1,000 for those who did not. A double-blind, randomized, placebo-controlled trial in rural Nepal revealed that vitamin A supplementation of VAD populations during pregnancy can have a major impact on maternal mortality.

It is true that high doses of vitamin A cause birth defects. The fetus is most vulnerable in the first two months of pregnancy but it is not certain whether higher doses later in pregnancy are safe. However beta-carotene is the safest way to supplement pregnant women, because it is not teratogenic and is recommended over vitamin A which has the possibility of teratogenicity.

Zinc status influences several aspects of vitamin A metabolism, including its absorption, transport, and utilization. Two common mechanisms postulated to explain this dependence relate to 1) the regulatory role of zinc in vitamin A transport mediated through protein synthesis, and 2) the oxidative conversion of retinol to retinal that requires the action of a zinc-dependent retinol dehydrogenase enzyme.

Two mechanisms are most often postulated to explain a potential dependence of vitamin A on zinc. One relates to a regulatory role of zinc on vitamin A transport mediated through protein synthesis (Mejia
LA 1986 and Terhune et al., 1972). Zinc deficiency can depress the synthesis of retinol-binding protein (RBP) in the liver and leads to lower concentration of RBP in the plasma. The other postulated mechanism is an interaction between vitamin A and zinc through the ubiquitous, oxidative conversion of retinol to retinaldehyde (retinal), a critical step in the metabolic pathway of vitamin A that is well described in the visual cycle in the retina of the eye and requires the action of a zinc-dependent retinol dehydrogenase enzyme (Huber et al., 1975 and Sundaresan et al., 1977).

A potential role of zinc deficiency may be hypothesized in the etiology of night blindness during pregnancy in relation to its interaction with vitamin A (Christian et al., 1998 and Smith et al., 1982). First, zinc is required in the hepatic synthesis or secretion of retinol binding protein (RBP), the transport protein of vitamin A. In zinc deficiency, RBP production can be reduced, resulting in secondary vitamin A deficiency that is reflected by low serum vitamin A concentration (Christian et al., 1998)). Thus, even in the presence of vitamin A adequacy, night blindness could occur when zinc deficiency exists. The other role of zinc may be in the visual cycle. Although zinc deficiency was previously thought to impair zinc-dependent 11-cis retinol dehydrogenase activity, the enzyme required for conversion of all-trans retinal to 11-cis retinal in the retina (Huber et al., 1975), it is now known that this enzyme is zinc independent (Doria et al., 1986, and Persson et al., 1995). However, numerous other enzymes important in the visual cycle (Saari et al., 1994) may likely be zinc dependent.

If there is deficiency of more than one micronutrient, supplementation with only one micronutrient will not adequately
address all needs. Moreover, the benefit of supplementing with one micronutrient can be compromised by the presence of deficiency of other micronutrients, thus reducing effectiveness of the supplementation. For example, supplementation of zinc in addition to beta-carotene with standard supplementation of iron and folic acid reduces the prevalence of vitamin A deficiency and vitamin A status both more than does zinc or beta-carotene supplementation alone (Suharno et al., 1993). One or both nutrients, may, reasonably expect to alter the metabolism of each other, with functional consequences on the health of the individual especially during pregnancy. Therefore present research project has been taken with the following objectives:

- To determine Zinc and β-carotene content in commonly edible foods.
- To assess the prevalence of Zinc and Vitamin A deficiencies during pregnancy.
- To see the impact of Zinc, β-carotene supplementation alone as well as in combination on pregnancy outcomes.