Chapter I

Introduction
1. INTRODUCTION

Pregnancy is a natural phenomenon during which women encounter a wide range of internal physical physiological changes (Al-Shoshan, 2007). It is a period of rapid growth and cell differentiation, both for the mother and the fetus. Consequently, it is a period when both are very susceptible to alterations in dietary supply, especially of nutrients which are marginal under normal circumstances. The period of intrauterine nourishment, growth and development is one of the most vulnerable periods which affect nutrition status of fetus (Muthayya, 2009). Mother’s diet should provide adequate nutrients so that maternal stores do not get depleted and the needs of the growing fetus can be met without damaging mother’s health (Singh et al., 2009).

Nutritional adequacy both in quantity and quality during pregnancy period is important for the physical and mental development of the infant and later on, of the child (Riz et al., 2002; Rogers et al., 1998). Adequate maternal nutrition plays a key role in normal pregnancy progress, optimal fetal development and normal birth weight of the fetous (King, 2000b).

Birth weight plays an important role in infant development and future health of the child. Low birth weight (LBW) is a significant risk factor for adverse health outcomes, including many childhood diseases (Boucher, 2002). The association between LBW and a greatly elevated risk of infant mortality (Joseph and Kramer, 1997; Shi et al., 2004), and other physical and neurologic impairment (Hack, 2006; Whitaker et al., 1997), is well established. The weight of the infant at birth is a powerful predictor of infant growth and survival, and is dependent on maternal health and nutrition during pregnancy (Godfrey and Barker, 2000). Adequate maternal nutrition plays a key role in normal pregnancy progress and optimal fetal development. Proper diet during pregnancy should provide an appropriate amount of energy and all essential nutrients, such as protein, fats, carbohydrates, vitamins and minerals (Bolesta and Szostak-Wegierek, 2009).

During pregnancy, additional energy is required for the growth and maintenance of the fetus, the placenta, and maternal tissues. Energy metabolism changes during the course of pregnancy and differs considerably among women (Ebbs et al., 1942; Forsum and Löf, 2007). Maternal basal metabolism increases because of
the increased mass of metabolically active tissues; maternal cardiovascular, renal, and respiratory work; and new tissue synthesis. If the energy intake of chronically undernourished women does not increase during pregnancy, fetal and maternal tissue growth may be limited to that which can be attained by adjustments in nutrient utilization (Institute of Medicine, 1990).

Maternal protein intake was found to be associated with birth weight of the neonates (Moore et al., 2004; Olsen et al., 2007; Rao et al., 2001b). Inadequate intake of protein during pregnancy was reported as an important cause of LBW in most of the countries (Rosenberg et al., 2003; Alam, 2001; Cohen et al., 2001; Mathews et al., 1999).

Inadequate stores or intake of vitamins or minerals during pregnancy period have adverse effects on the mother, such as anemia, hypertension, complications of labor and even death. Furthermore, the fetus can be affected, resulting in stillbirth, pre-term delivery, intrauterine growth retardation, congenital malformations, reduced immune-competence and abnormal organ development (Ramakrishnan et al., 1999). Inadequate intake of micronutrient in gestational period is recognized as a major public health problem in many developing countries (Jiang et al., 2005; Pathak et al., 2004a) (Christian, 2003; Huffman et al., 1998; Ramakrishnan, 2002; Seshadri, 2001). Maternal micronutrient deficiency predisposes a mother to poor health, including infection, preeclampsia/eclampsia, and adverse pregnancy outcomes such as premature birth and intrauterine growth retardation (Huffman et al., 1998; Ramakrishnan, 2002). Deficiency of some elements such as calcium, iron and zinc in maternal diet can influence birth weight.

Calcium is needed in pregnancy and adequate calcium during pregnancy lowers blood pressure and may reduce the incidence of premature and low birth weight (Abu-Saad and Fraser, 2010).

Iron deficiency, i.e., anaemia, increases the risk of low birth weight. Iron is an important micronutrient and is necessary for hemoglobin (Hb) synthesis and several other important functions in the body. Iron deficiency can result not only in reduced oxygen carrying capacity due to lowered hemoglobin levels, but can also affect
immunity and growth and development. Thus, iron deficiency anemia during pregnancy has the potential for adverse effect on the mother and the newborn. In developing countries, the prevalence of iron deficiency anemia in pregnant women ranges from 35% to 75%, and is recognized as the most common nutritional problem in the world (Huffman et al., 1998; Ramakrishnan, 2002; Seshadri, 2001; World Health Organization, 1992). Anemia in pregnancy contributes to maternal deaths and may also contribute to adverse birth outcomes including intrauterine growth retardation and prematurity and hence to perinatal morbidity and mortality (WHO, 1991). There is substantial evidence showing that maternal iron-deficiency anemia prior to and in early pregnancy places the mother at increased risk of preterm birth or low-birth-weight delivery (Allen, 2000; Scholl, 2005a). Severe anemia (hemoglobin level <80 g/L) is associated with the birth of small babies, as a consequence of both preterm labor and growth restriction. The minimum incidence of low birth weight and preterm birth is found when hemoglobin concentration is in normal which is 95-150 g/L (Steer, 2000).

Zinc is required for cellular division and differentiation, and is an essential nutrient for normal embryogenesis (Al-Bader et al., 1997b; Izquierdo Álvarez et al., 2007). Zinc is a co-factor for the synthesis of a number of enzymes, DNA and RNA (Pathak and Kapil, 2004). Inadequate zinc during the prenatal period has been particularly linked with low birth weight, pre-eclampsia, premature rupture of membranes, and pre-term delivery, fetal growth retardation, vaginal bleeding, and congenital abnormalities (Caulfield et al., 1999; Lu et al., 2003; Neggers et al., 1991; Trindade, 2005).

Another micronutrient which has an important role on the proper nutritional status during gestational period is copper. Copper is an essential trace element for enzyme systems such as catalase, superoxide dismutase and cytochrome oxidase systems, and its deficiency can lead to a variety of nutritional and vascular disorders during pregnancy (Al-Bader et al., 1997a; Izquierdo Álvarez et al., 2007; Kocyigit et al., 2004).

A number of recent epidemiological findings have implicated magnesium as being an essential element for fetal well being. Trials have documented that oral
supplementation of magnesium during pregnancy reduces pregnancy hypertension, miscarriage, premature birth and foetal growth retardation (Almonte et al., 1999b; Chien et al., 1996; Fawcett et al., 1999a; Fawcett et al., 1999b; Jeswani and Vani, 1991a; Tamura et al., 2000a). Maternal nutrition plays a crucial role in influencing fetal growth and birth outcomes.

Maternal nutrients intake, normal maternal body mass index before conception, and gestational weight gain are associated with proper fetal development (Baeten et al., 2001; Bolesta and Szostak-Wegierek, 2009; Lu et al., 2003; Neggers et al., 1995a). Gestational weight gain during pregnancy influence infant birth weight (Kramer et al., 2002b). A strong relationship between maternal pregnancy weight gain and birth weight has been demonstrated consistently and low maternal weight gain is considered as a preventable risk factor for LBW (Matthews et al., 2004).

Assessment of dietary intake during pregnancy is important because it is well established that nutrient deficiencies can have adverse effects on pregnancy outcome (Abu-Saad and Fraser, 2011; Gold, 1971). Unfortunately, effective nutrition guidance in prenatal care is ignored and pregnant women during pregnancy are deprived of nutritional assessment programme. Nutrition guidelines should be improved and the importance of nutrition during pregnancy period should be highlighted.

It is stated that maternal nutrition and preventing adverse birth outcomes, particularly among developing/low-income populations are important factors from a public health point of view. The available literature suggests that the interventions to improve neonatal outcome must start much before the childbirth because a woman's adverse nutritional status is detrimental to the birth weight and survival of her children. Therefore, there is an urgent need to determine ways and means to prevent LBW and its consequences.

Maternal nutritional factors and consequently birth weight of neonates should be given in high priority. In Iran, studies on birth weight of neonates and related etiologic factors, especially the nutritional status and micronutrients levels (Calcium, iron, zinc, copper and magnesium) during the three trimesters of pregnancy are very few. Since the relationship between the birth weight of infants and the maternal
nutritional status demands further attention, this investigation was carried out in Khoy city which is located in the province of western Azarbayjan with the following objectives:

**Major Objectives:**

- To assess the maternal nutritional and micronutrient status during three trimesters of pregnancy
- To assess the nutritional and micronutrient status of neonates
- To find out the association between maternal micronutrient status and birth weight of neonates.